Relating the Mission and Means Framework to DoD Architecture Framework Products

Jim Watkins
Applied Research Laboratories
The University of Texas

Game Plan

- **Historical Perspectives on Architecture Frameworks**
- **DoD Architecture Framework Views and Products**
- **Mission and Means Framework**
- **Relating MMF Levels and Operators to DoD AF Views and Products**
- **Conclusions**

Historical Perspectives

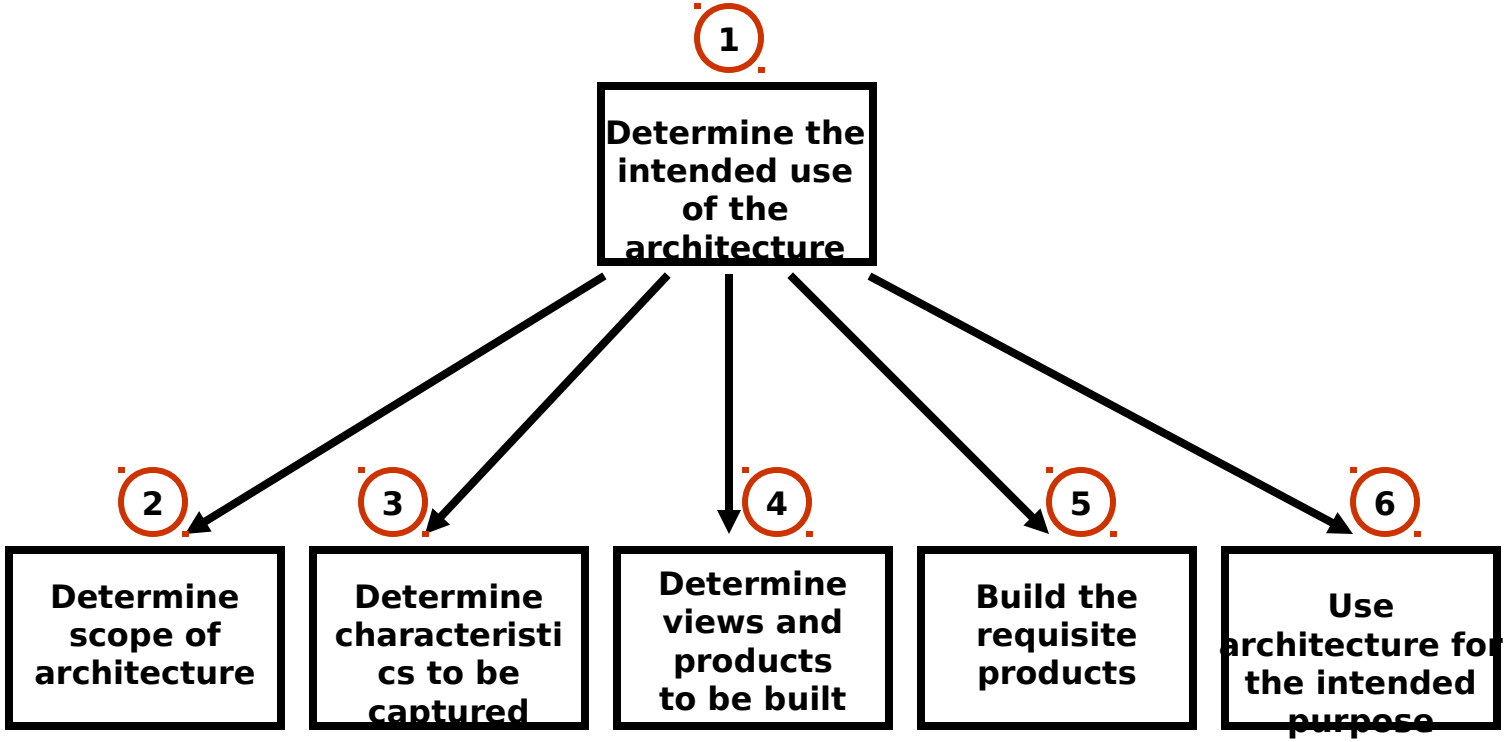
- **Command and Control experiences in Grenada, Desert Storm, etc**
- **Government Performance and Results Act of 1993**
- **Information Technology Management Reform Act of 1996 (Clinger-Cohen)**
- **Defense Science Board, et al**
- **C4ISR Architecture Framework, Version 1.0, 7 June 1996**
- **C4ISR Architecture Framework, Version 2.0 18 Dec 1997**
- **OSD Memo, 23 Feb 1998: Strategic Direction for a DoD Architecture Framework**
  USD(A&T), ASD(C3I), and J6
- **DoD Architecture Framework (30 August 2003)**

Architecture Description

*A representation of a defined domain in terms of its **component parts**, what these parts **do**, how the parts **relate** to each other, and the **rules and constraints** under which the parts function*

- Descriptions can vary widely with regard to degree of detail
  - Domains can be extraordinarily broad (e.g. DoD) or narrow (one component of a communications network)
  - Functional descriptions of domains can be very general or specific
  - Rules and constraints can be high-level and broad or task-level and specific

The Architecture Description Process



Integrated Architecture

Definition: An architecture consisting of multiple **views** (operational, systems, and technical standards) that facilitate **integration** and promote **interoperability** across family-of-systems (FoS), system-of-systems (SoS) and **compatibility** among related mission area architectures.

DoDD 4630.5, Jan 11, 2002

Interoperability and Supportability of Information Technology and National Security Systems

Integrated architectures provide a logical, structured approach for defining how forces **operate**, the associated **information flow**, the relation between that information flow and **system capabilities**, and the relation between system capabilities and **technical standards**.

Architecture Framework

- What it consists of
  - Common definitions, products, data, and references
- What it does
  - Provides **guidance** on how to describe architectures
  - Provides a generic problem space and a common vocabulary within which individuals can cooperate to solve a specific problem
  - Provides the rules, guidance, and product descriptions for developing and presenting architecture descriptions that ensure a common denominator for **understanding**, **comparing**, and **integrating** architectures
  - Can be leveraged to provide at least a starter set of issues and concerns that must be addressed in architecture development
- What it does not do
  - Provide guidance on how to **design** or **implement** a specific architecture
  - Provide guidance on how to **develop** or **acquire** systems

Architecture and Engineering
A Dynamic Tension

Architecture: *The structure of components, their relationships, and the principles and guidelines governing their design and evolution over time.*

DoD Integrated Architecture Panel 1995, based on IEEE STD 610.12

The architect: articulates through the design the vision of the operator

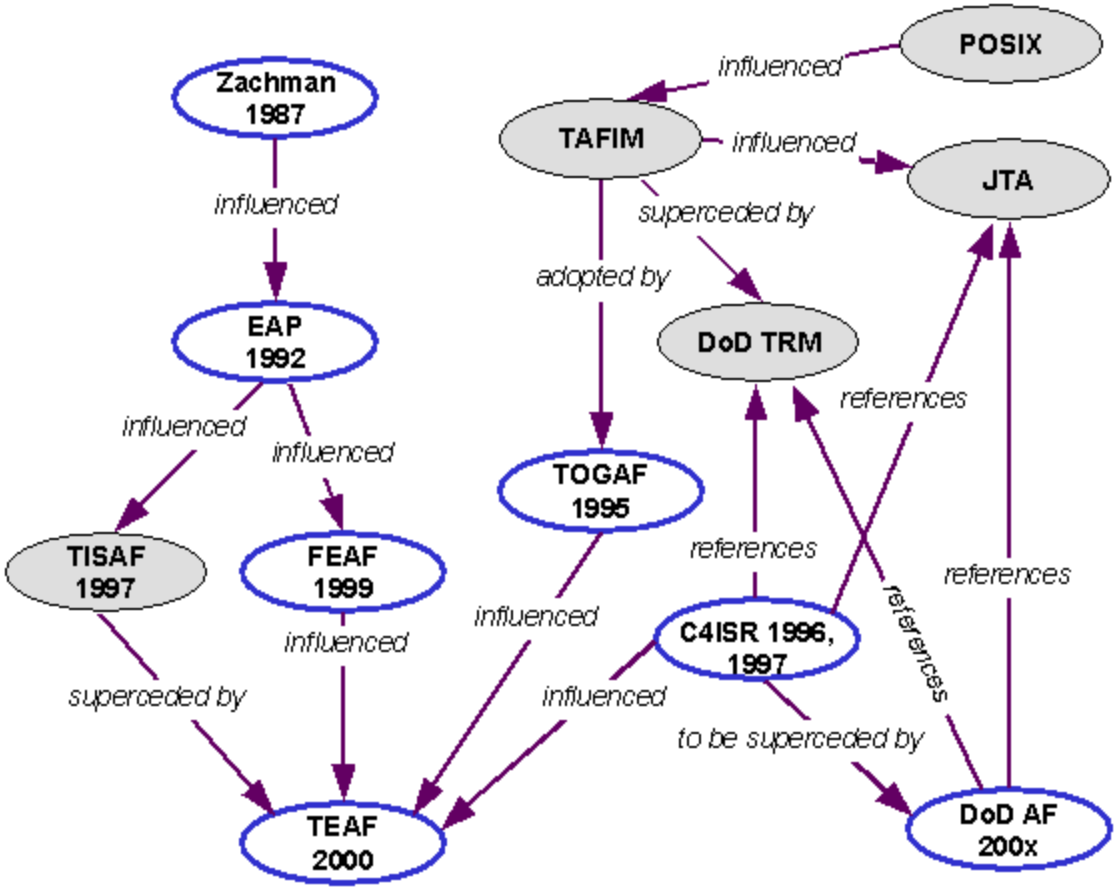
System: A set of interacting components in which the behavior of each component affects the behavior of the whole set

Systems Engineering: *The design, production, and maintenance of trustworthy systems within cost and time constraints*

An interdisciplinary process that ensures that a customer's needs are satisfied throughout a system's entire life-cycle

The system engineer: implements a system that conforms to the architecture within cost and time constraints

The Architecture Frameworks Quagmire



DoD Architecture Framework, Version 1.0 Final Draft – 30 August 2003

- **http://www.eaframeworks.com/DoDAF/**

- **Defines a common approach for DoD architecture description development, presentation, and integration for both warfighting operations and business operations and processes**

- **Three volumes:**
  1. **Definitions and Guidelines**
  2. **Product Descriptions**
  3. **Deskbook**

Volume I – Definitions and Guidelines

Introduction: Purpose, scope, architecture descriptions, definitions of views, definitions of products, integrated architectures, history of the framework

Related Government Policy and Legislation

Architecture Uses: Representative uses of three views, linkages among views, relationships among products, uses of integrated architectures, products according to use

Techniques for Using Architecture Information: Capability-based analysis, Mission Capability Packages, key interface profiles, human factors, architecture measures,

Architecture Guidelines, Description Process, and Integration

Architecture Data Model, Repository, and Tools

Architecture Framework Evolution

Glossary, Dictionary, and References

Volume II – Product Descriptions

Introduction

Architecture Basics – Views, Products, and Architecture Data:

Architecture Views, Products, Data Elements, Product Development, Product and Architecture Data Element Relationships, CADM Support for Architecture Products

All-Views Products (AV)

Operational View Products (OV)

Systems View Products (SV)

Technical Standards View Products (TV)

Framework Architecture Data Element Relationships:

Logical linkages among architecture data elements underlying the products and the views

Volume III – Deskbook

Provides supplementary guidance to Framework users. Unlike the guidance provided in Volumes I and II, the techniques presented are not mandatory.

Techniques for Developing Architectures

- Requirements-based architecture development
- Dept of the Navy CIO process guidance
- Example architecture using structured analysis and UML
- USSPACECOM architecture developed with OO methodology
- Security/Information Assurance architecture
- An architecture perspective on NCOW
- Representing the role of humans in architectures
- Capability Maturity profile
- Architecture Level of Detail

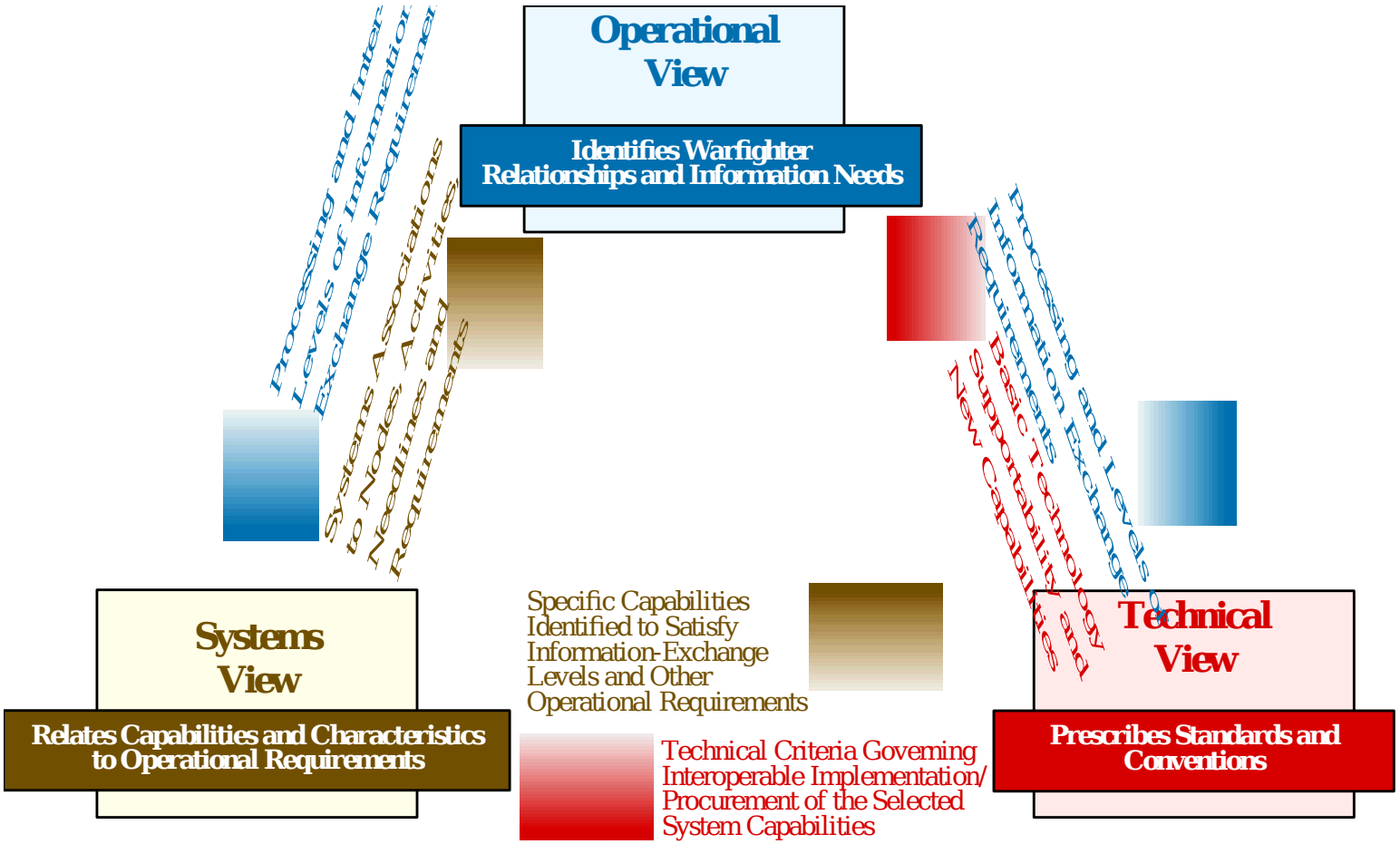
Techniques for Using Architectures

- Air Force Capability-Based Analysis
- Navy's Mission Capability Package Approach
- Key Interface Profiles
- C4I Support Plans
- Role of Architectures in CPIC

Additional Information

- Architectural Concepts and CADM
- Architectural Modeling and Repository Tools
- Federal Enterprise Architecture Reference Models – Relationship to DoD Architecture Framework
- Universal Reference Resources
  - e.g. UJTL, CADM, DDDS, GIG, COE

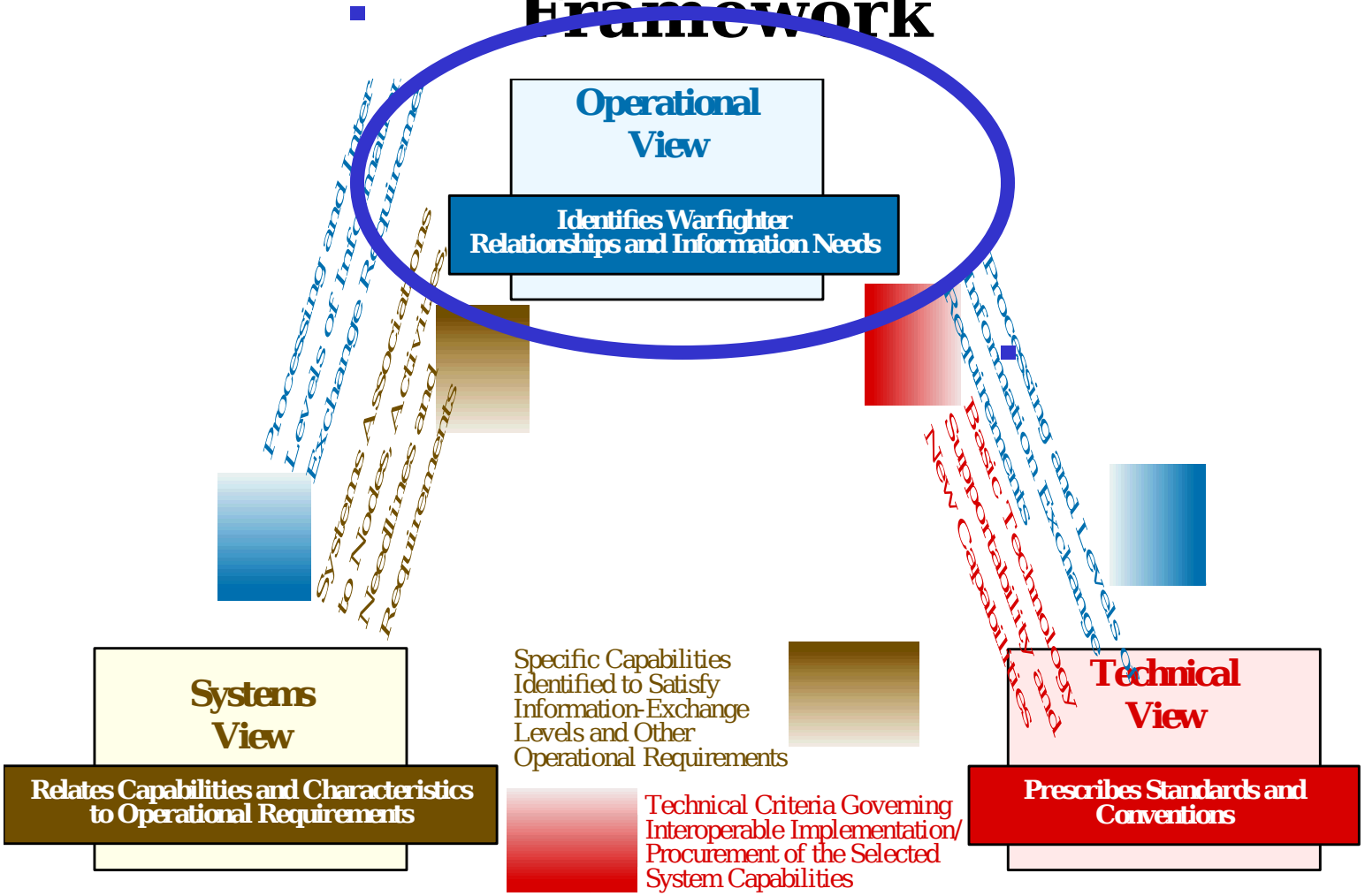
Three Views of the Architectural Framework


Operational View
Identifies Warfighter Relationships and Information Needs
Processing and Levels
Information Exchange
Requirements
Basic Technology
Supportability and
New Capabilities
Systems View
Relates Capabilities and Characteristics to Operational Requirements
Specific Capabilities Identified to Satisfy Information-Exchange Levels and Other Operational Requirements
Technical View
Prescribes Standards and Conventions
Technical Criteria Governing Interoperable Implementation/ Procurement of the Selected System Capabilities

Architecture Description Guiding Principles

- Should be built with a Purpose in Mind
- Should be as Simple and Straightforward as Possible
- Should Facilitate, Not Impede, Communication Among Humans
- Should be Relatable and Comparable Across DoD
- Should be Modular, Reusable, and Decomposable

Three Views of the Architectural Framework

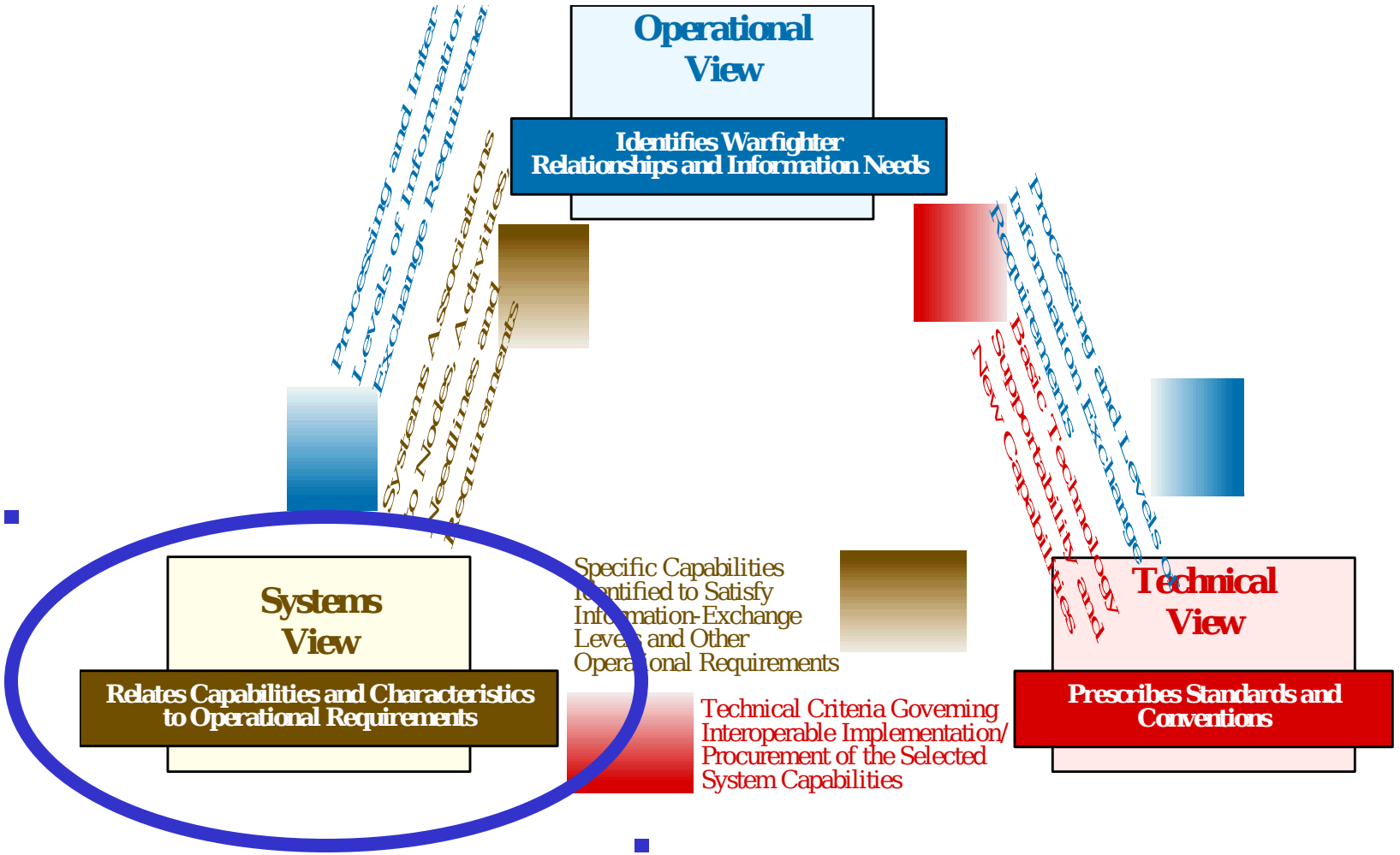

Operational View
Identifies Warfighter Relationships and Information Needs
Processing and Levels of Information Exchange Requirements
Systems Associations to Nodes, Activities, Needlines and Requirements
Processing and Levels of Information Exchange Requirements
Basic Technology Supportability and New Capabilities
Systems View
Relates Capabilities and Characteristics to Operational Requirements
Specific Capabilities Identified to Satisfy Information-Exchange Levels and Other Operational Requirements
Technical View
Prescribes Standards and Conventions
Technical Criteria Governing Interoperable Implementation/ Procurement of the Selected System Capabilities

Operational View (OV)

*A description of the **tasks** and **activities**, **operational elements**, and **information exchanges** required to accomplish DoD missions (including both warfighting missions and business processes)*

- Contains graphical and textual products
- **Identifies**:
  - operational nodes and elements
  - assigned tasks and activities
  - information flows required between nodes
- **Defines**:
  - types of information exchanged
  - frequency of information exchange
  - which tasks and activities are supported by the information exchanges
  - nature of information exchanges in detail sufficient to ascertain specific interoperability requirements
- **OV Tenets**
  - Generally driven by doctrine
  - Generally independent of organization or force structure
  - Generally independent of technology
  - Should clearly identify the time phase(s) covered

Three Views of the Architectural Framework

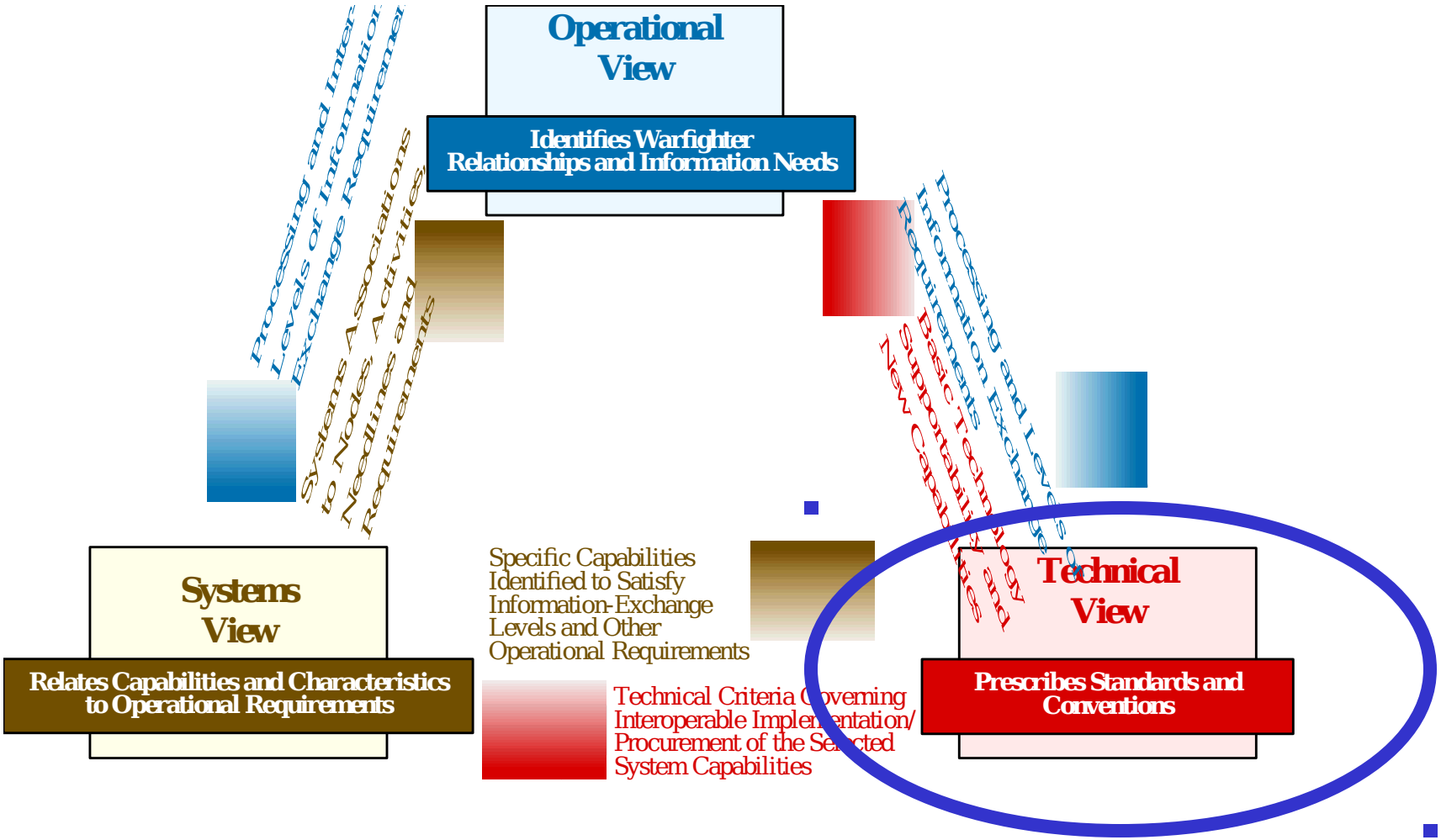

Operational View
Identifies Warfighter Relationships and Information Needs
Processing and Levels of Information Exchange Requirements
Systems Associations to Nodes, Activities, Needlines and Requirements
Processing and Levels of Information Exchange Requirements
Basic Technology Supportability and New Capabilities
Systems View
Relates Capabilities and Characteristics to Operational Requirements
Specific Capabilities Identified to Satisfy Information-Exchange Levels and Other Operational Requirements
Technical View
Prescribes Standards and Conventions
Technical Criteria Governing Interoperable Implementation/ Procurement of the Selected System Capabilities

Systems View (SV)

*A description, including graphics, of the **systems** and **interconnections** providing for, or supporting, DoD functions*

- **For a domain**
  - shows how multiple systems link and interoperate
  - may describe the internal construction and operations of particular systems within the architecture
- **For the individual system**
  - includes the physical connection, location, and identification of key hardware and software
  - may include data stores, circuits, and networks
  - may specify system and component performance parameters
- **The Systems View associates physical resources and their performance attributes to the operational view and its requirements per standards defined in the Technical Standards View**
- **SV Tenets**
  - Primary purpose is to enable or facilitate operational tasks and activities
  - Maps systems back to the operational architecture
  - Identifies system interfaces and defines connectivities between systems
  - Defines system constraints and bounds of system performance behavior
  - **Are** technology-dependent, showing how multiple systems link and interoperate
  - Can support multiple organizations and missions
  - Are based upon and constrained by technical architectures

Three Views of the Architectural Framework


Operational View
Identifies Warfighter Relationships and Information Needs
Processing and Interoperability Levels of Information Exchange Requirements
Systems Associations to Nodes, Activities, Needlines and Requirements
Processing and Levels of Information Exchange Requirements
Basic Technology Supportability and New Capabilities
Systems View
Relates Capabilities and Characteristics to Operational Requirements
Specific Capabilities Identified to Satisfy Information-Exchange Levels and Other Operational Requirements
Technical Criteria Governing Interoperable Implementation/ Procurement of the Selected System Capabilities
Technical View
Prescribes Standards and Conventions

Technical (Standards) View (TV)

*The minimal set of **rules** governing the **arrangement**, **interaction**, and **interdependence** of system parts or elements whose purpose is to **ensure that a conformant system satisfies a specified set of requirements**.*

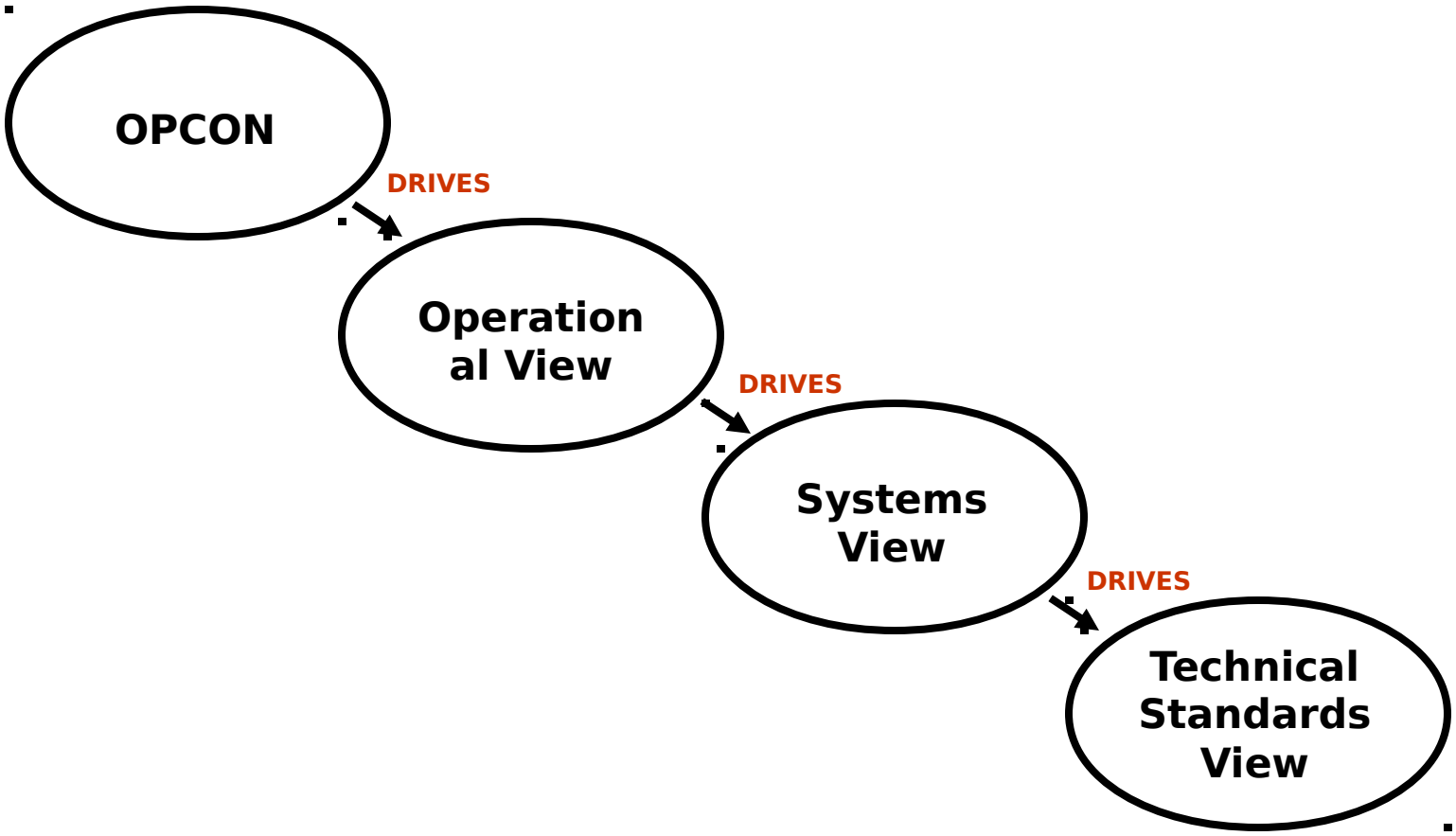
- **Provides the technical systems-implementation guidelines upon which**
  - Engineering specifications are based
  - Common building blocks are established
  - Product lines are developed

- **Includes a collection of the**
  - Technical standards
  - Implementation conventions
  - Standard options
  - Rules and criteria

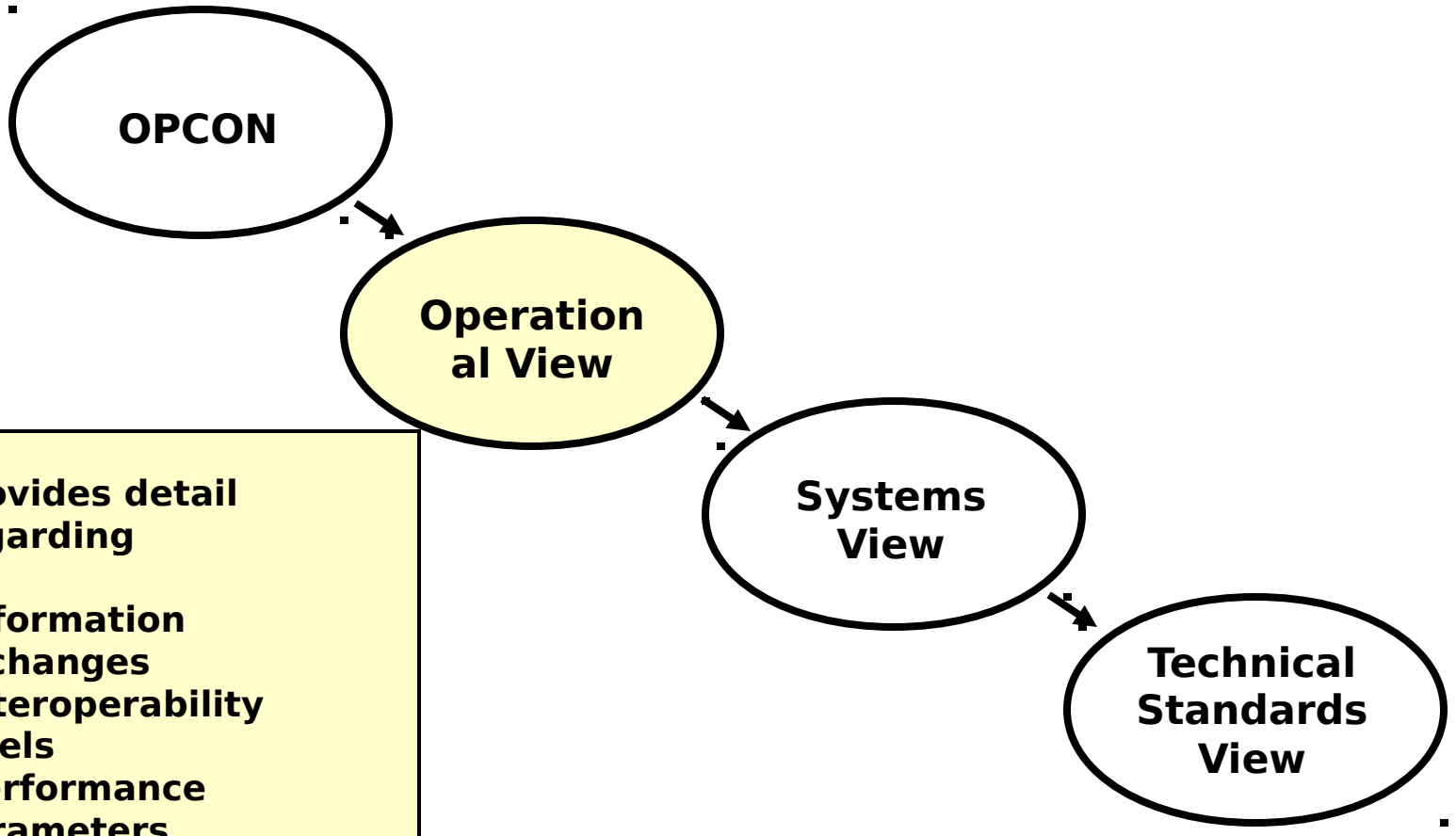
  that govern system components and interfaces for a given architecture

- **TV Tenets**
  - Based on associations between operational requirements and their supporting systems, enabling technologies, and appropriate interoperability criteria
  - Primary purpose is to define the set of standards and rules that govern system implementation and system operation
  - It is constructed from an enterprise-wide set of standards and design rules
  - It should reflect multiple information system implementation paradigms
  - Must accommodate new technology, evolving standards, and the phasing out of old technology
  - Should be driven by commercial standards and direction

Linkages Among the Views



Linkages Among the Views

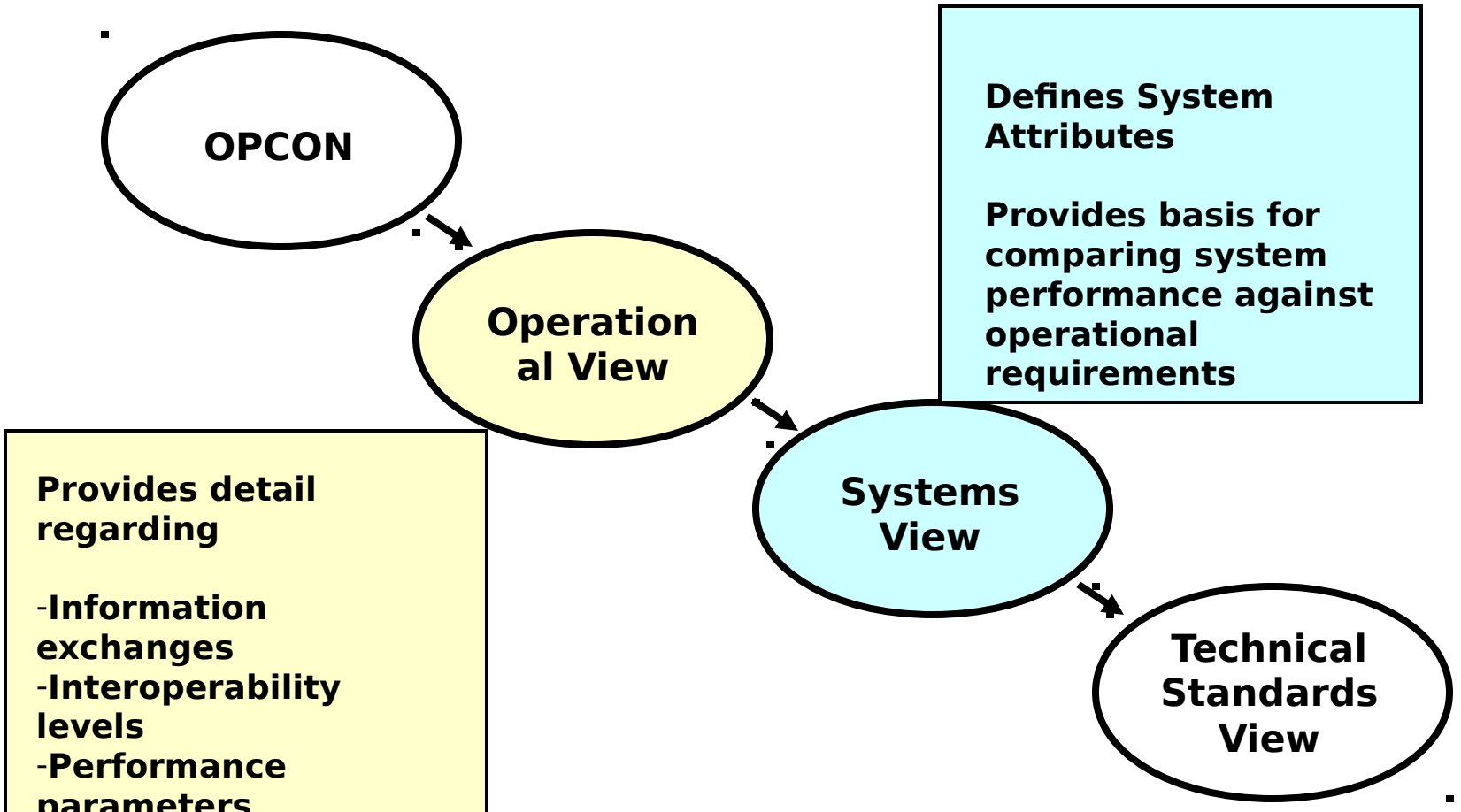


Provides detail regarding

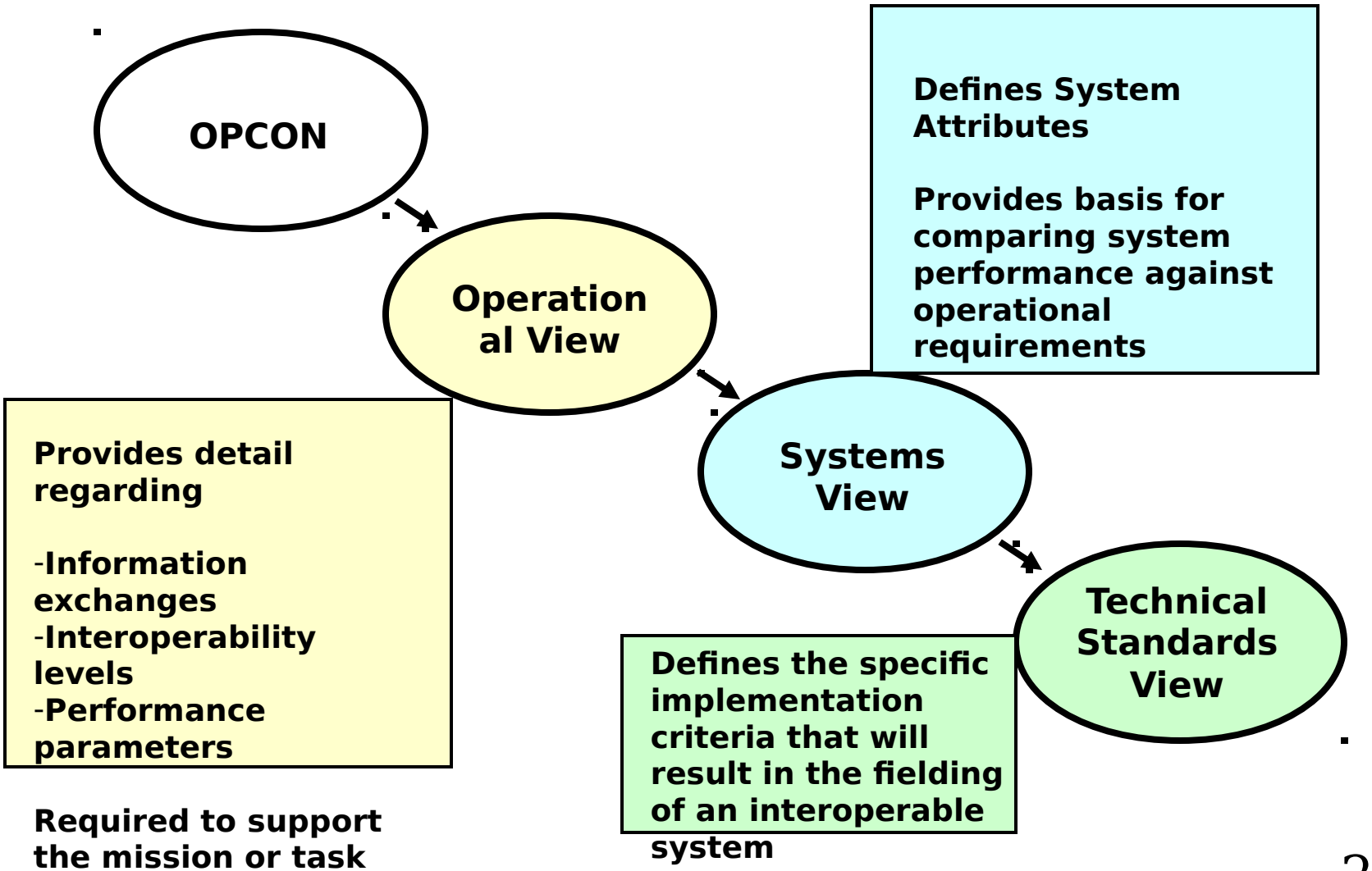
-Information exchanges
-Interoperability levels
-Performance parameters

Required to support the mission or task

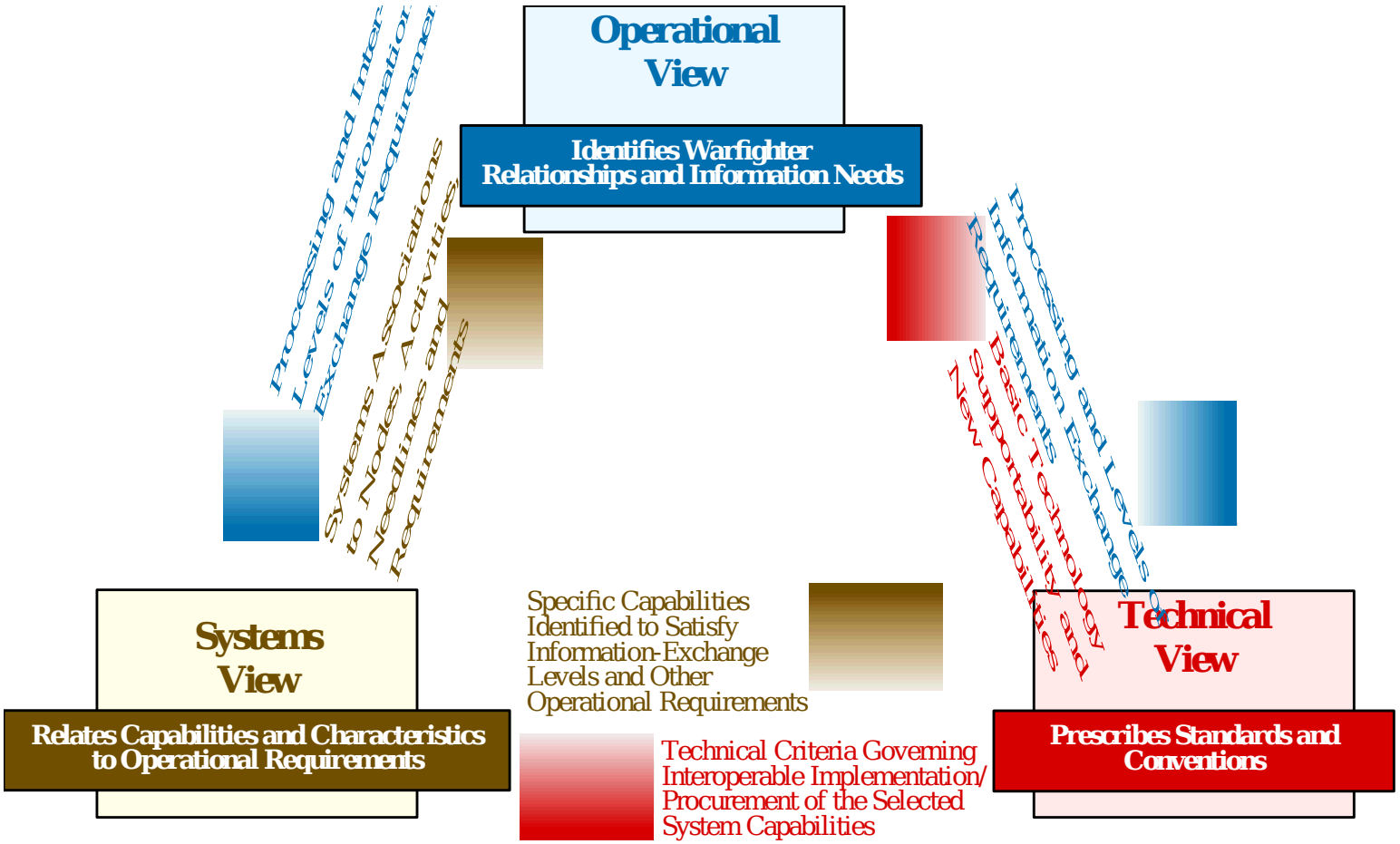
Linkages Among the Views



Linkages Among the Views


OPCON
Operation al View
Systems View
Technical Standards View
Defines System Attributes
Provides basis for comparing system performance against operational requirements
Provides detail regarding
-Information exchanges
-Interoperability levels
-Performance parameters
Required to support the mission or task
Defines the specific implementation criteria that will result in the fielding of an interoperable system

The Interrelationship Between Architecture Views


Operational View
Identifies Warfighter Relationships and Information Needs
Processing and Levels of Information Exchange Requirements
Systems Associations to Nodes, Activities, Needlines and Requirements
Processing and Levels of Information Exchange Requirements
Basic Technology Supportability and New Capabilities
Systems View
Relates Capabilities and Characteristics to Operational Requirements
Specific Capabilities Identified to Satisfy Information-Exchange Levels and Other Operational Requirements
Technical View
Prescribes Standards and Conventions
Technical Criteria Governing Interoperable Implementation/ Procurement of the Selected System Capabilities

Architecture Products

Those graphical, textual, and tabular items that are developed in the course of building a given architecture description and that ***describe characteristics pertinent to the purpose*** *of the architecture*

The products that should be developed for a given architecture depend on the intended use of the architecture

Architecture Products

All Views

Product	Product Name	General Description
AV-1	Overview and Summary Information	Scope, purpose, intended users, environ depicted, analytical findings
AV-2	Integrated Dictionary	Data repository with definitions of all ter used in all products

All Views

AV-1
Overview and Summary Information

Overview and Summary Information

- Identification
  - Name
  - Architect
  - Organizations Involved
  - When Developed
- Purpose
  - Analysis Needs
  - Decision Support Needs
  -
  -
- Scope
  - Views and Products Used
  - Time Frames Addressed
  -
  -
- Context
  - Mission
  - Geographical
  - Rules, Criteria, and Conventions Followed
  -
  -
- Findings
  - Results
  - Recommendations
- Tools and File Formats

AV-2
Integrated Dictionary

Textual product presenting the definitions and metadata associated with all architectural product graphical items.

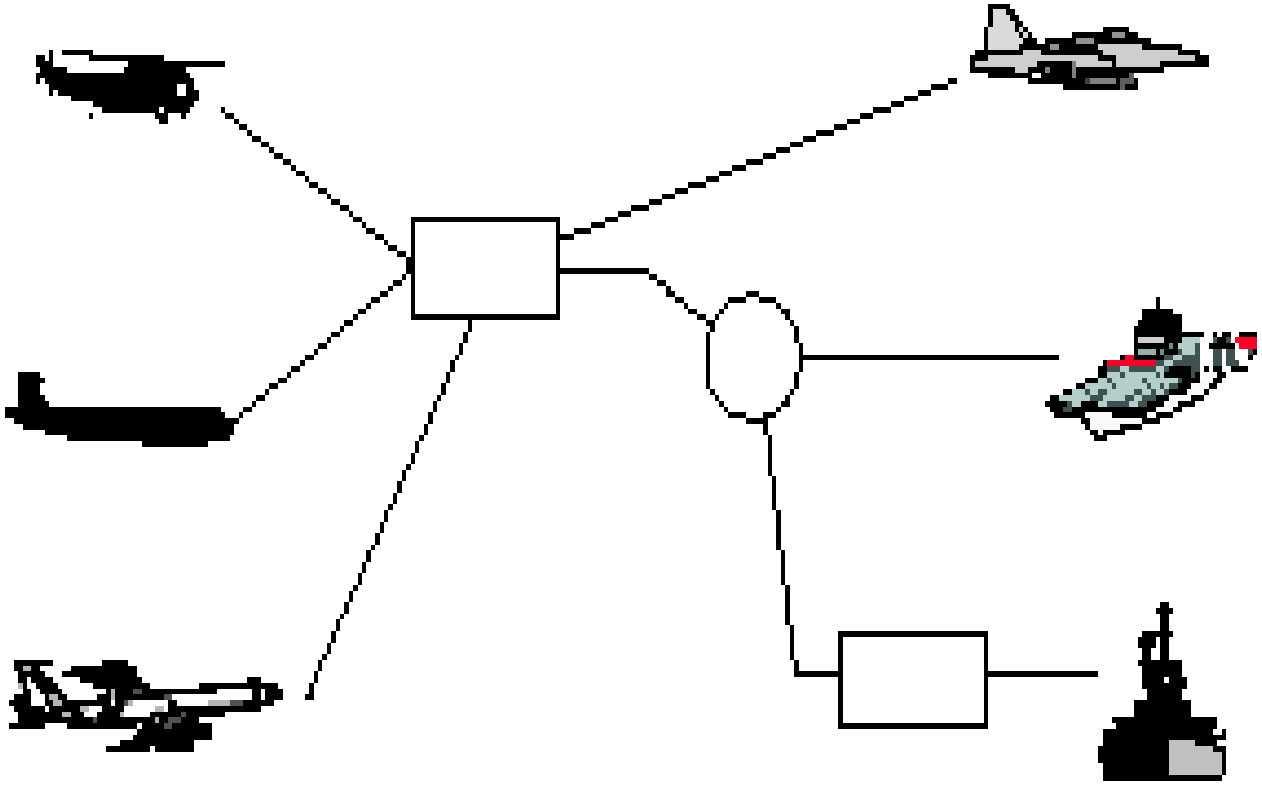
Each labeled graphical item (e.g. icon, box, or connecting line) in the graphical representation of a product should have a corresponding entry in the Integrated Dictionary

Architecture Products

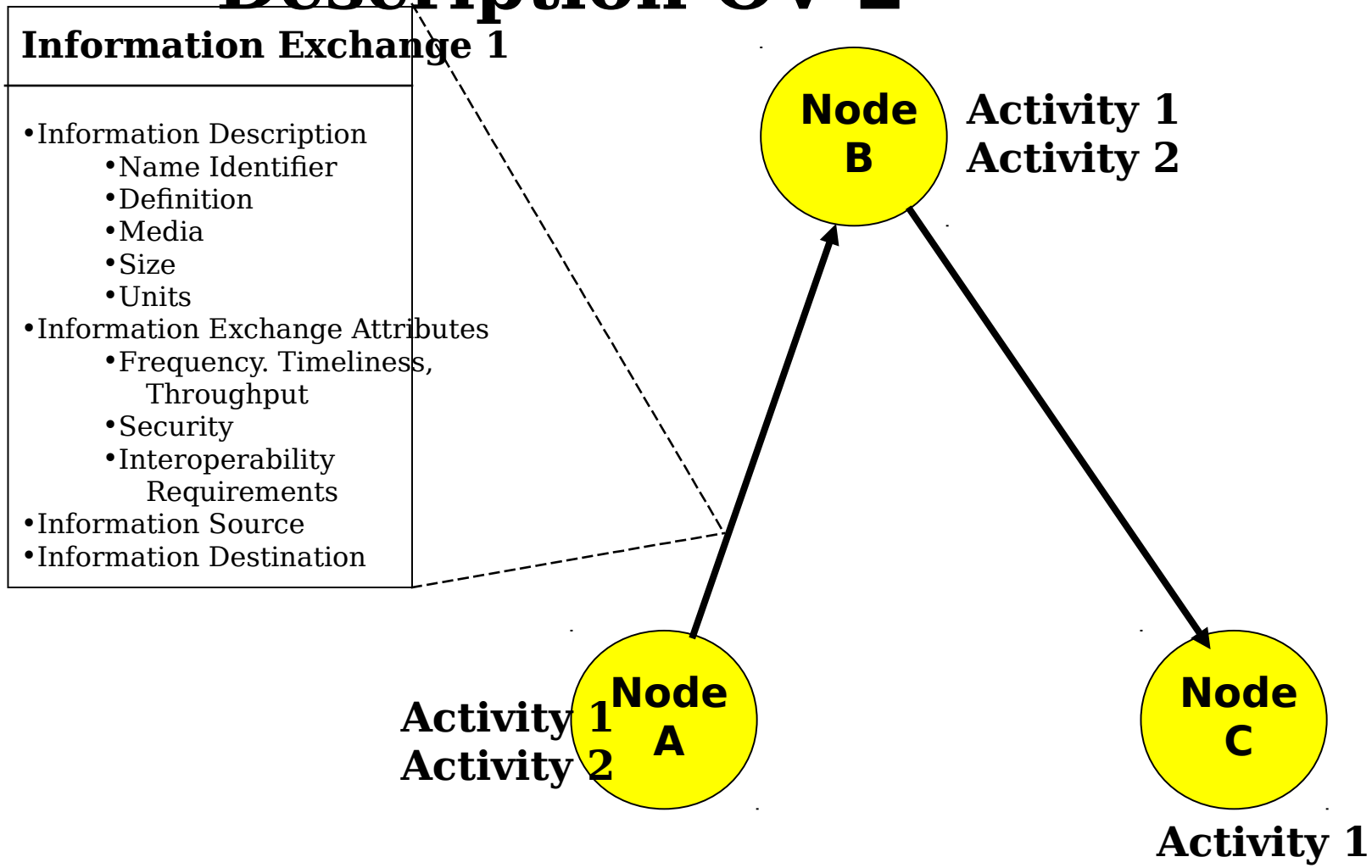
Operational Views

Product	Product Name	General Description
OV-1	High-Level Operational Graphic	High-level graphical/textual description of operational concept
OV-2	Operational Node Connectivity Description	Operational nodes, operational activities performed at each no connectivity and information exchange needlines be
OV-3	Operational Information Exchange Matrix	Information exchanged between nodes and the relev attributes of the exchange
OV-4	Organizational Relationships Chart	Organizational, role, or other relationships among o
OV-5	Operational Activity Model	Operational activities, relationships among activities, inputs ar Overlays can show cost, performing nodes, or other pertinent i
OV-6a	Operational Rules Model	One of the three products used to describe operatio and timing – identifies business rules that constrain operation
OV-6b	Operational State Transition Description	One of the three products used to describe operational activity and timing – identifies business process responses t
OV-6c	Operational Event-Trace Description	One of the three products used to describe operatio and timing – traces actions in a scenario or sequenc specifies timing of events
OV-7	Logical Data Model	Documentation of the data requirements and structural busine that constrain operation

High-Level Operational Graphic
OV-1



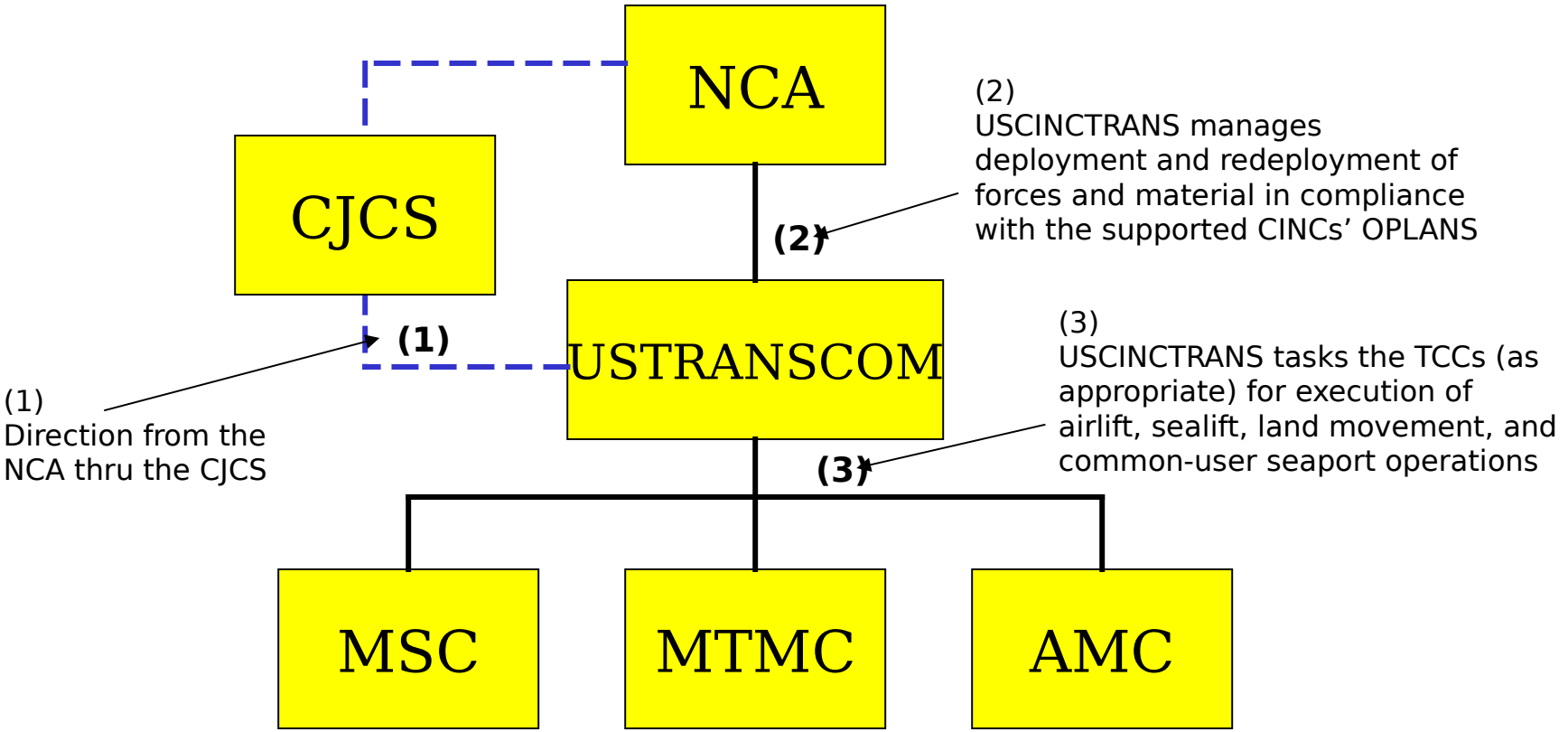
Operational Node Connectivity Description OV-2



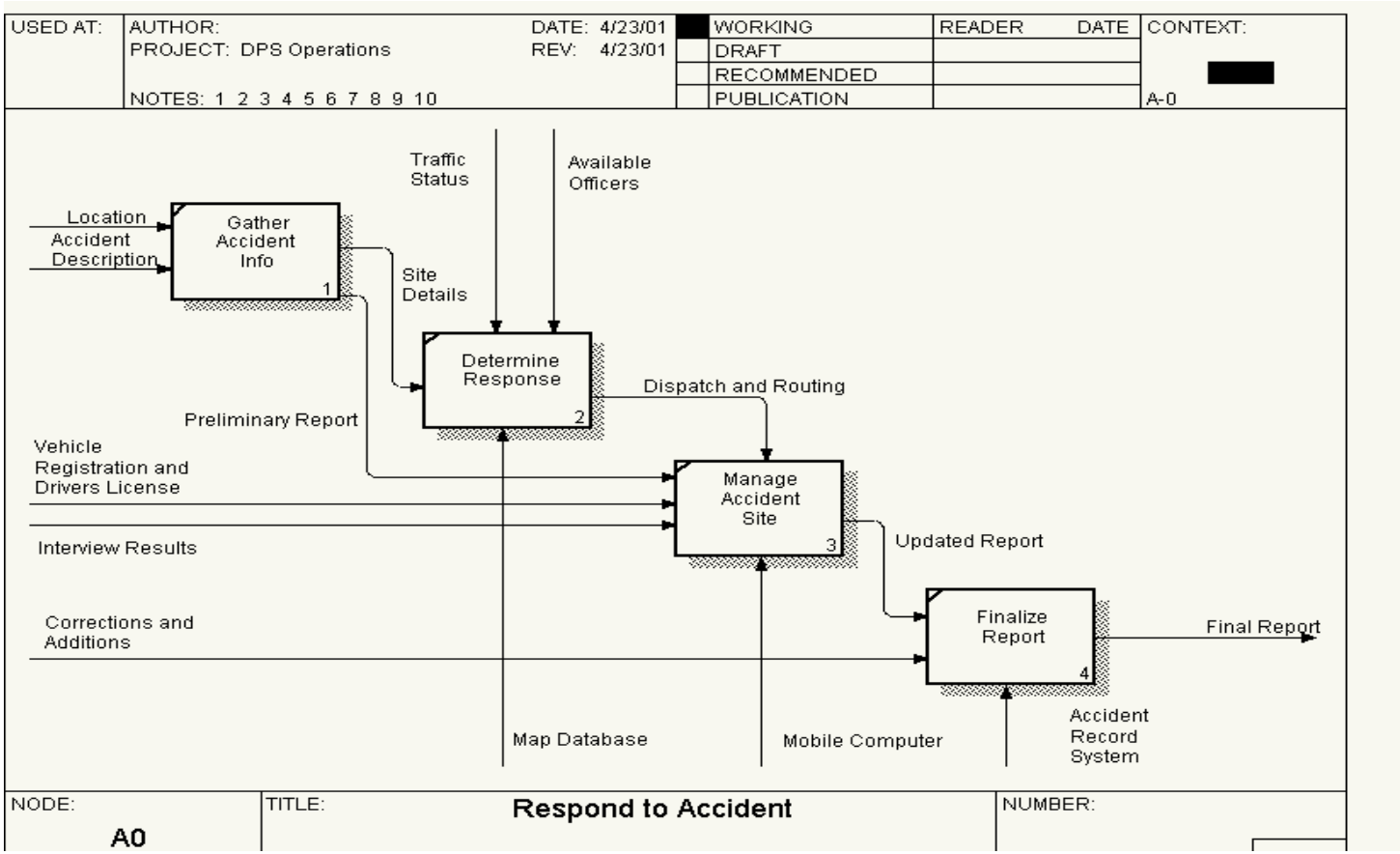
Operational Information Exchange Matrix OV-3

Information Description					Information Source		Information Destination		Information Exchange Attributes		
Operational Information Element	**Description**	**Media**	**Size**	**Units**	**Operational Element & Activity**		**Operational Element & Activity**		**Frequency, Timeliness, Throughput**	**Security**	**Interoperability Requirements**
Name/ Identifier	Definition	Digital, Voice, Text, Image, etc	Range Limits	Feet, Liters, Inches, etc	Identifier Of Producing OE	Producing Activity	Identifier Of Consuming OE	Consuming Activity			

Command Relationship Chart
OV-4

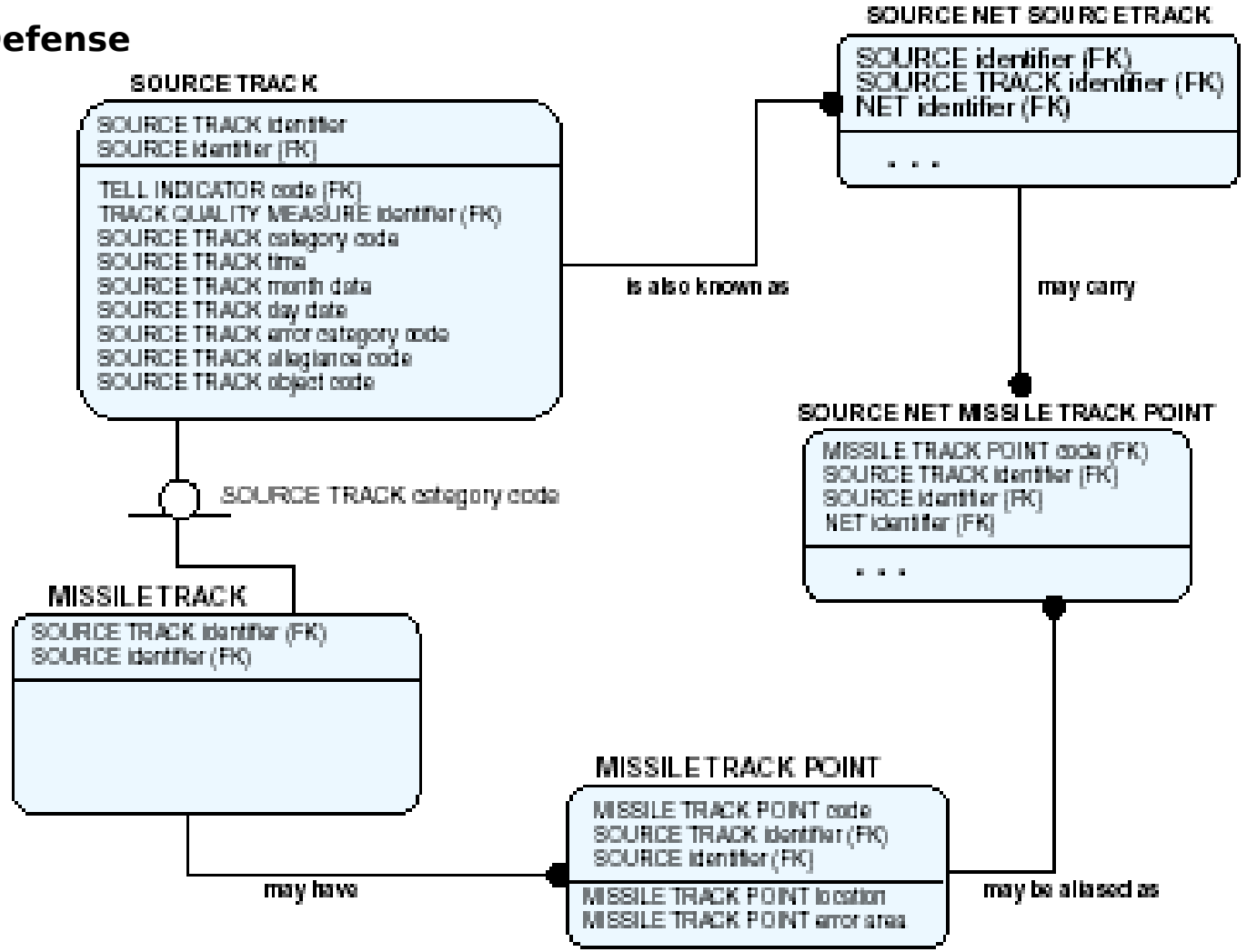


Operational Activity Model
OV-5



Operational Rules Model OV-6a

BMD Active Defense

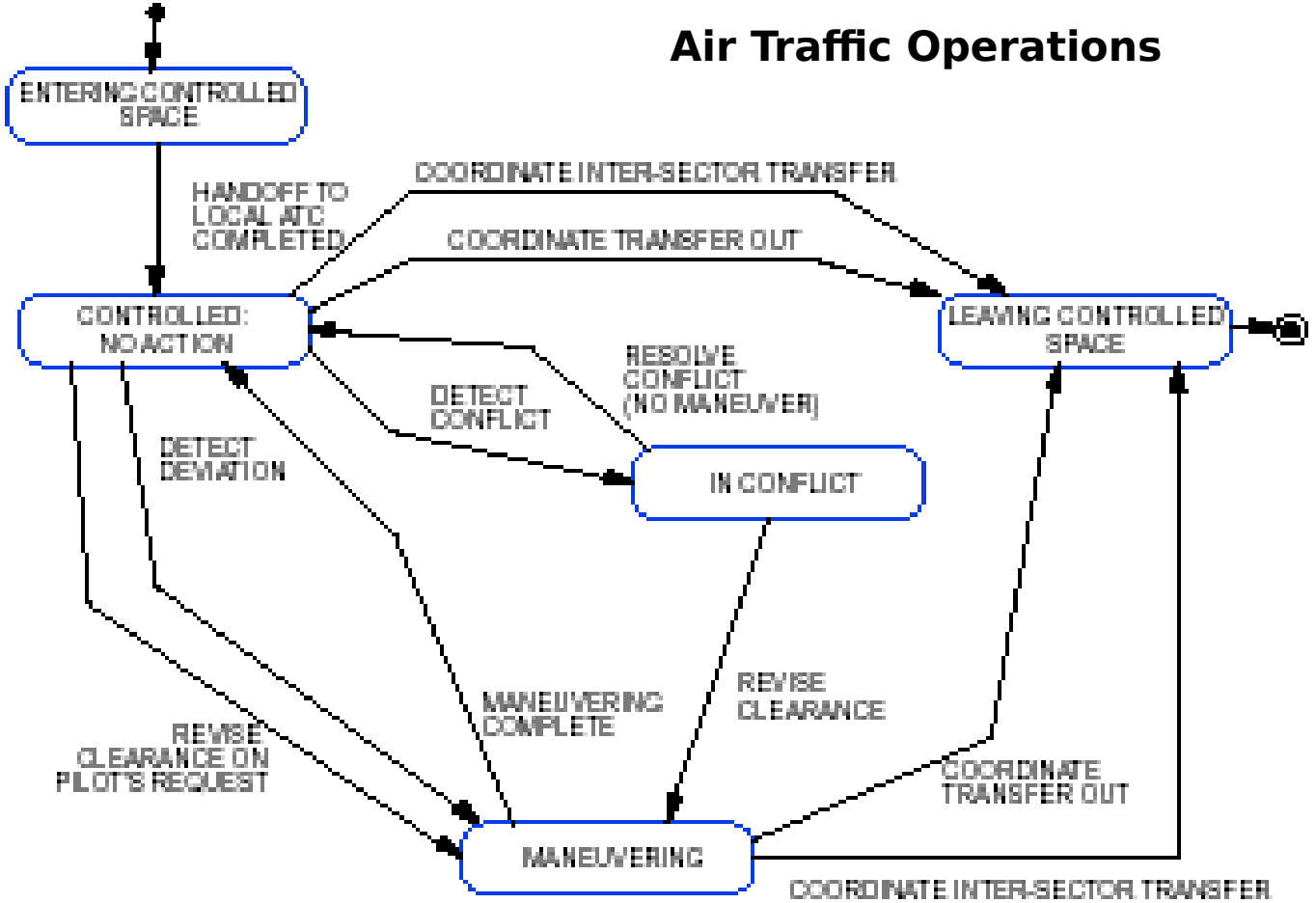


Operational Rules Model OV-6a

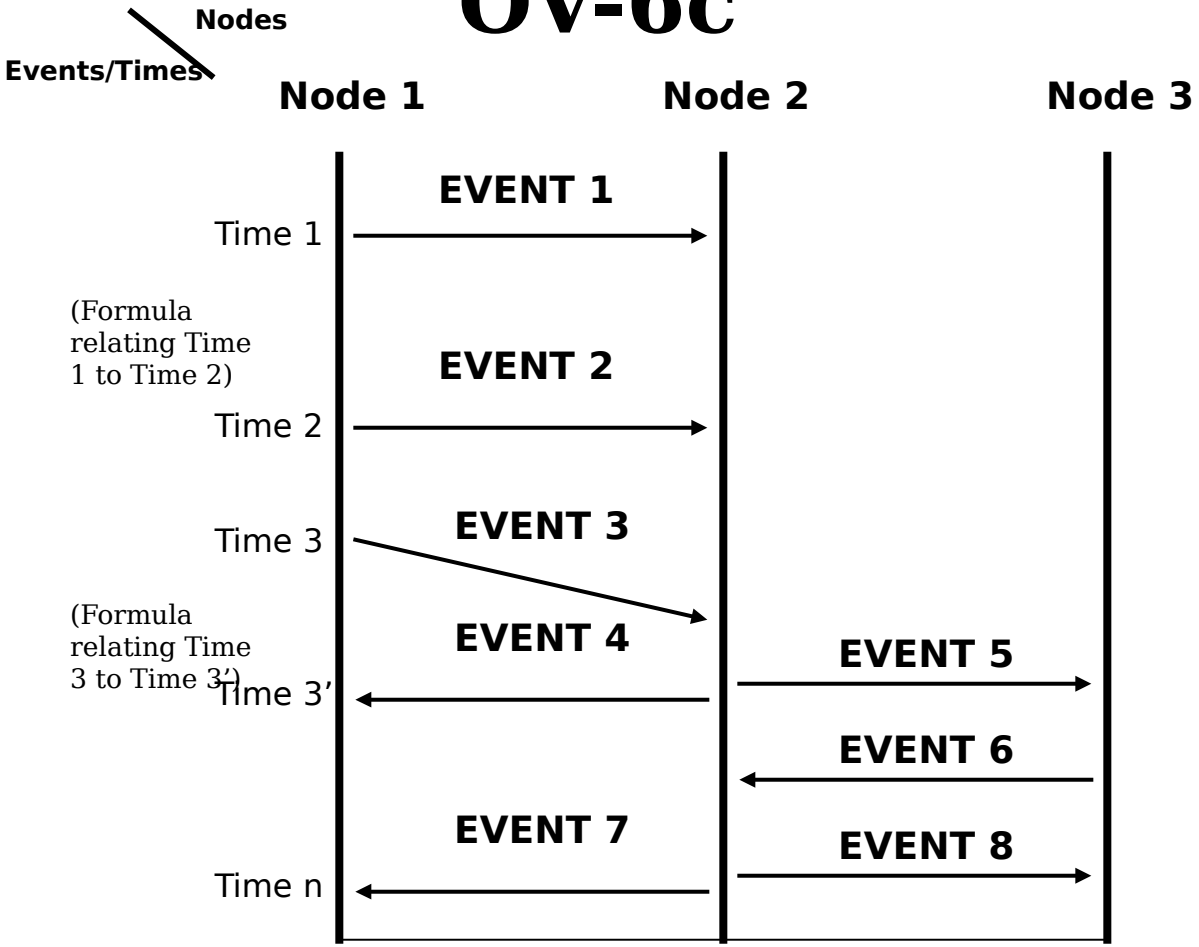
BMD Example Illustrating Action Assertion Rules in Structured En

For each MISSILE TRACK entity Instance
If MISSILE TRACK boost phase code > 0,
Then MISSILE TRACK acceleration rate *is non-null*
Else MISSILE TRACK drag effect rate *is non-null*
And
There Exists a MISSILE TRACK POINT entity instance *Such That*
MISSILE TRACK.SOURCE TRACK identifier =
MISSILE TRACK POINT.SOURCE TRACK identifier
And
MISSILE TRACK POINT.SOURCE identifier
End If
End For

Operational State Transition Description
OV-6b



Operational Event-Trace Description
OV-6c

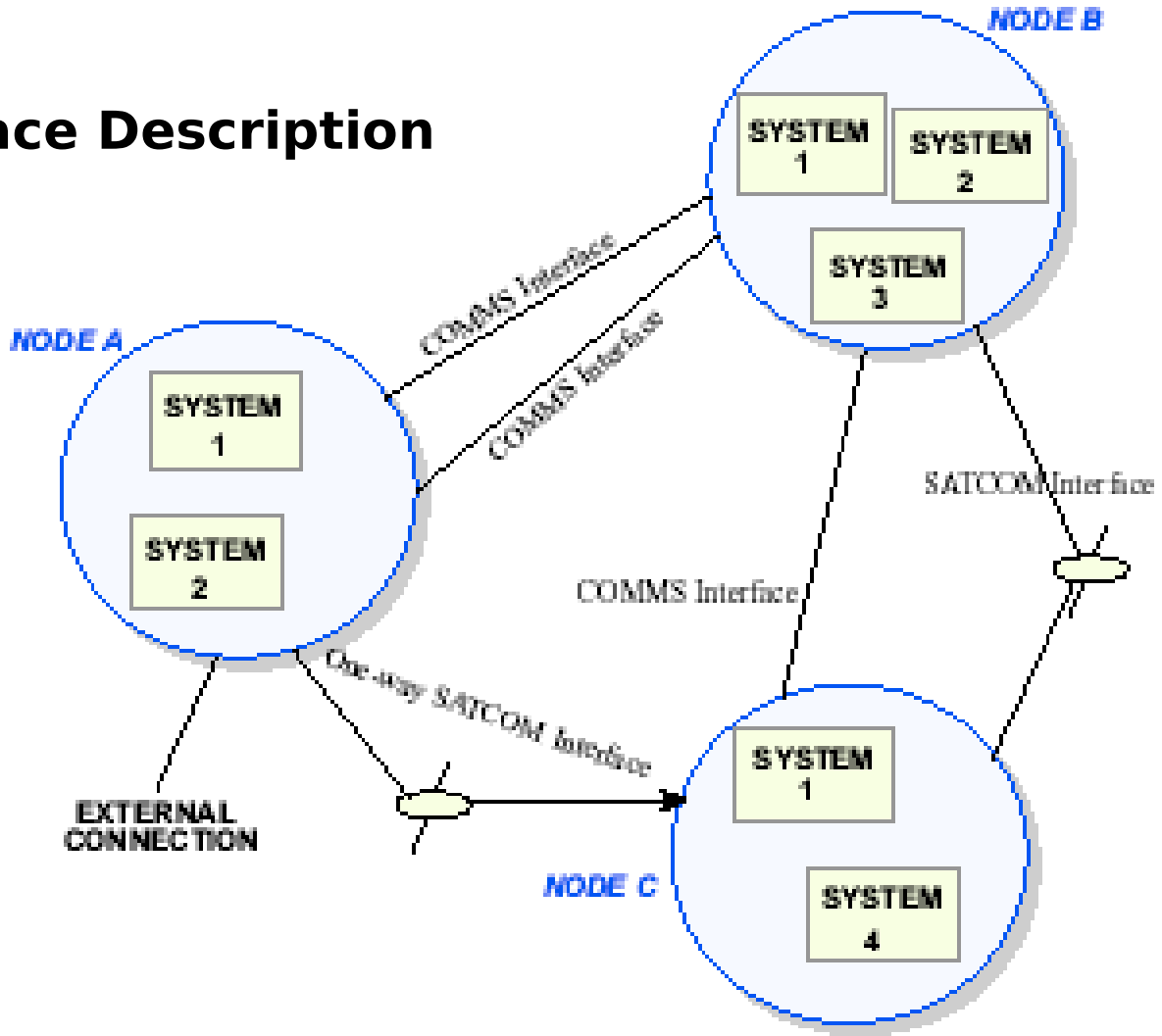


Architecture Products - Systems Views

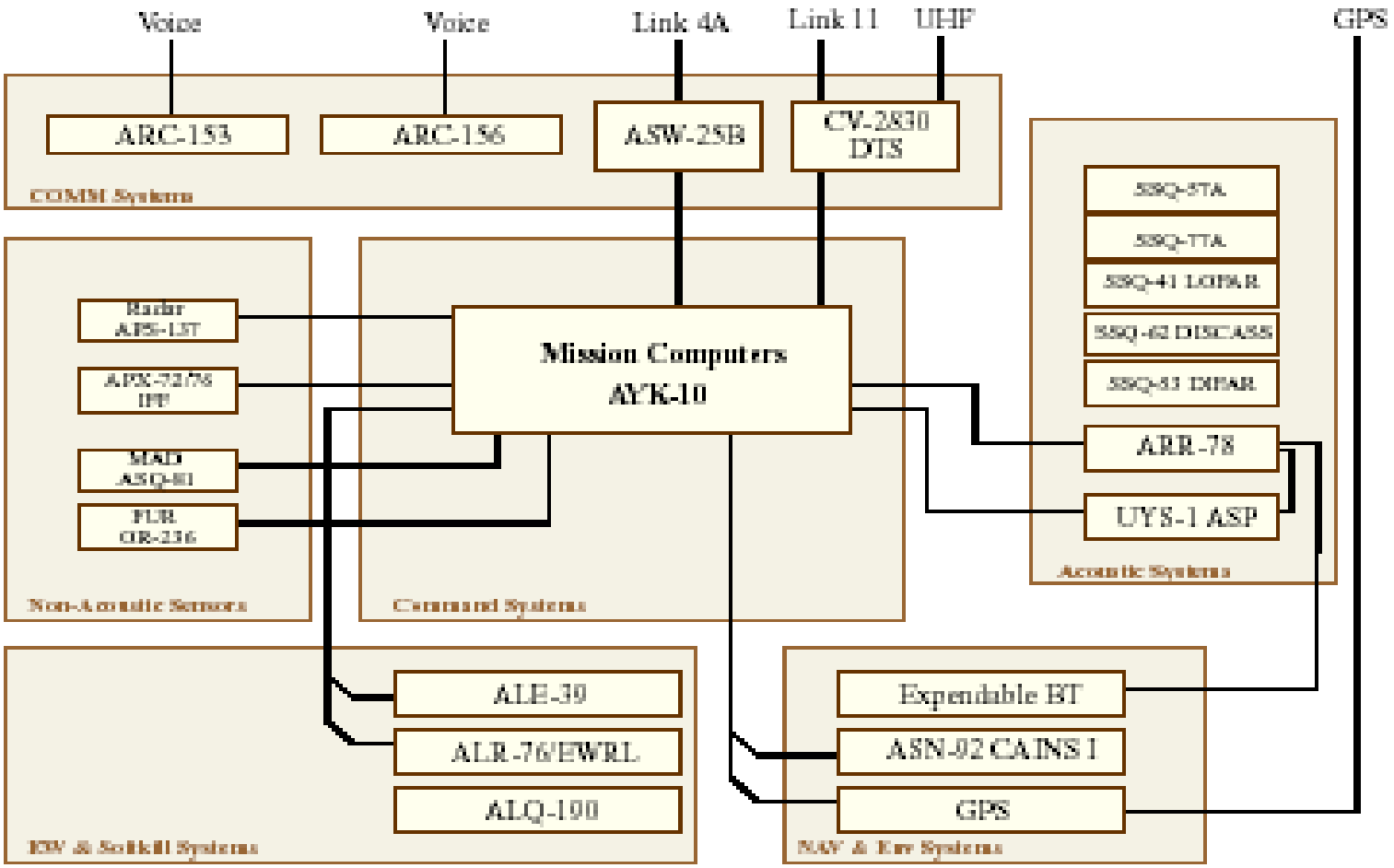
Product	Product Name	General Description
SV-1	Systems Interface Description	Identification of systems and systems components and their interconnections between nodes
SV-2	Systems Communication Description	System nodes and their related communications laydown
SV-3	System-Systems Matrix	Relationships among systems in a given architecture; can be designed to show relationships of interest, e.g. system-type interfaces
SV-4	Systems Functionality Description	Functions performed by systems and the info flow among sys functions
SV-5	Operational Activity to Systems Function Traceability Matrix	Mapping of systems back to operational capabilities or of system functions back to operational activities
SV-6	Systems Data Exchange Matrix	Provides details of systems data being exchanged between systems
SV-7	Systems Performance Parameters Matrix	Performance characteristics of each system(s) hardware and software elements, for the appropriate timeframe(s)
SV-8	Systems Evolution Description	Planned incremental steps toward migrating a suite of systems to a more efficient suite, or toward evolving a current sys to a future implementation
SV-9	Systems Technology Forecast	Emerging technologies and software/hardware products that are expected to be available in a given set of timeframes, and that will affect future development of the architecture

SV-1

System Interface Description

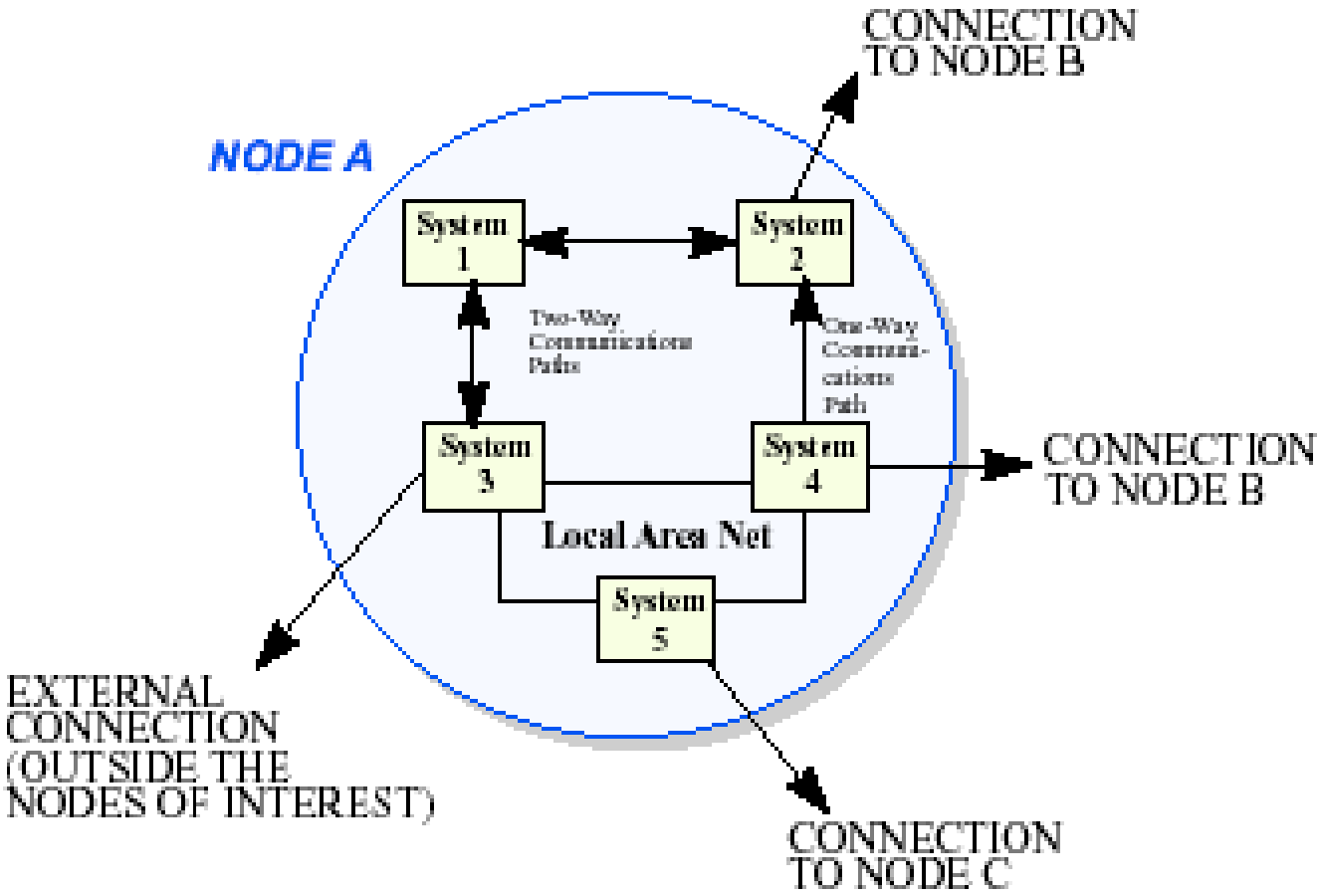


SV-1



System Interface Description, Intranodal Perspective

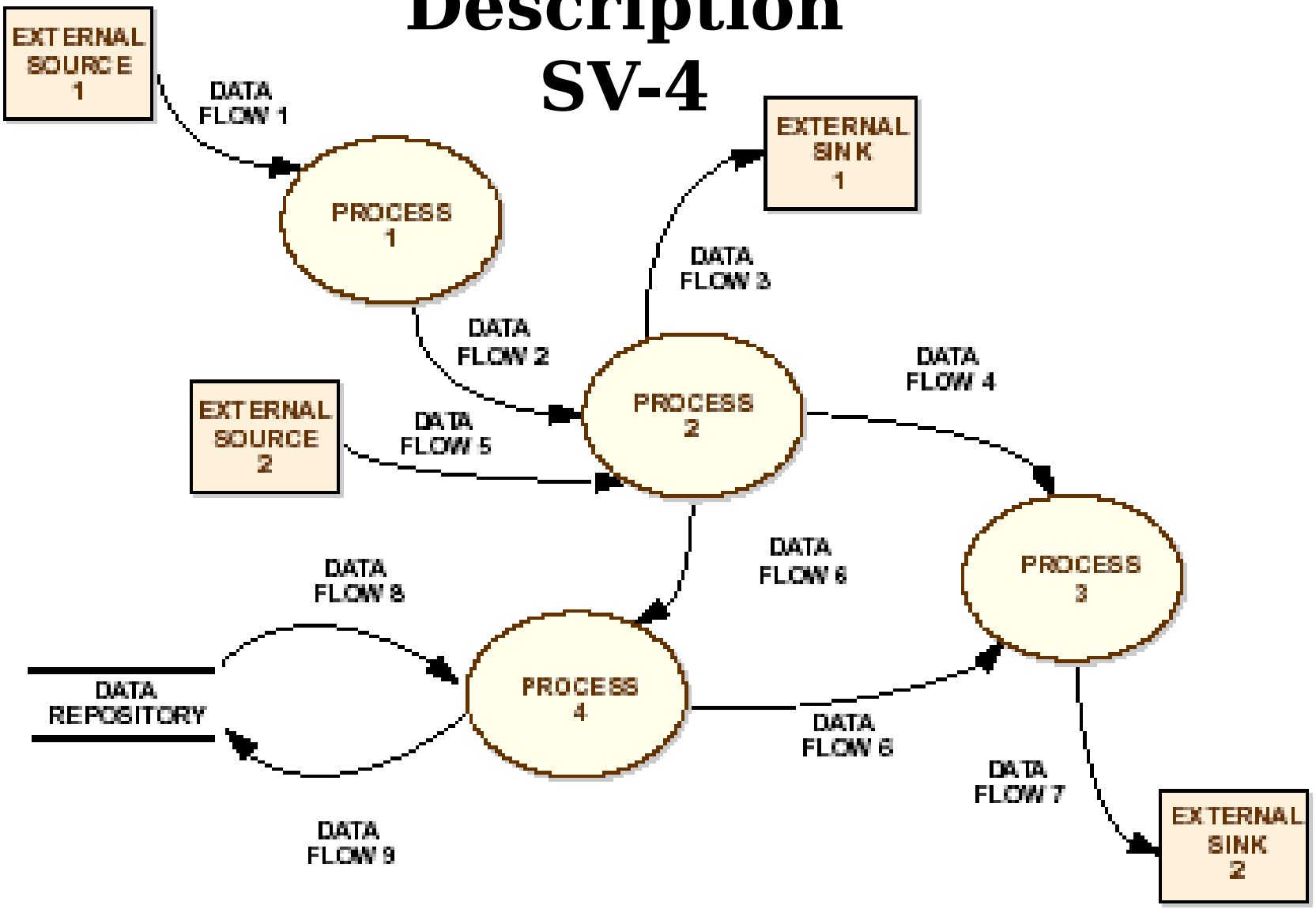
Systems Communications Description
SV-2



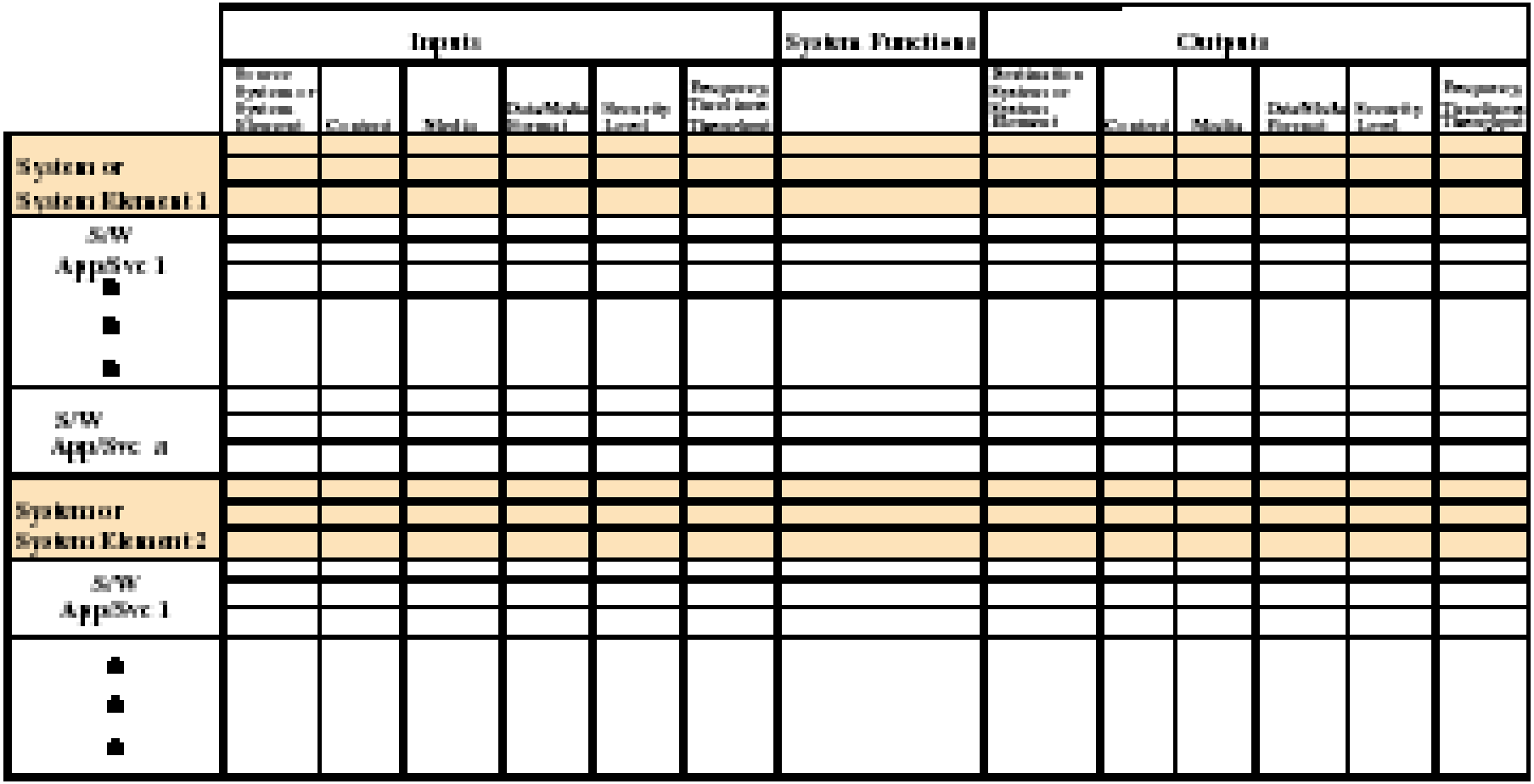
System-Systems Matrix SV-3

	GCCS	MCS/P	FBCB2	MIA2 SEP	M2A3	ASAS	CGS	GBCS	INETS	REMBAS
GCCS		■								
MCS/P	●		●	●	●	●				
FBCB2		●		●	●	●				
MIA2 SEP		●	●		●	●				
M2A3		●	●	●		●				
ASAS	●	●	●	●	●		●	●	●	●
CGS						●				
GBCS						●				
INETS						●				
REMBAS						●				
AFATDS	●	■	●	■	●	●				
BFIST			●	●	●					
Paladin										
FAAWS										
MLRS										
FAADC3I	●	■	●	■	●	●				
Avenger										
BSFW-E										
GBS										
CSSCS		●	●			●				
SAMS										
SAAS										
SPOS-R										
DAMMSR										
ULLS										
...										
...										

System Functionality Description SV-4



Systems Data Exchange Matrix
SV-6

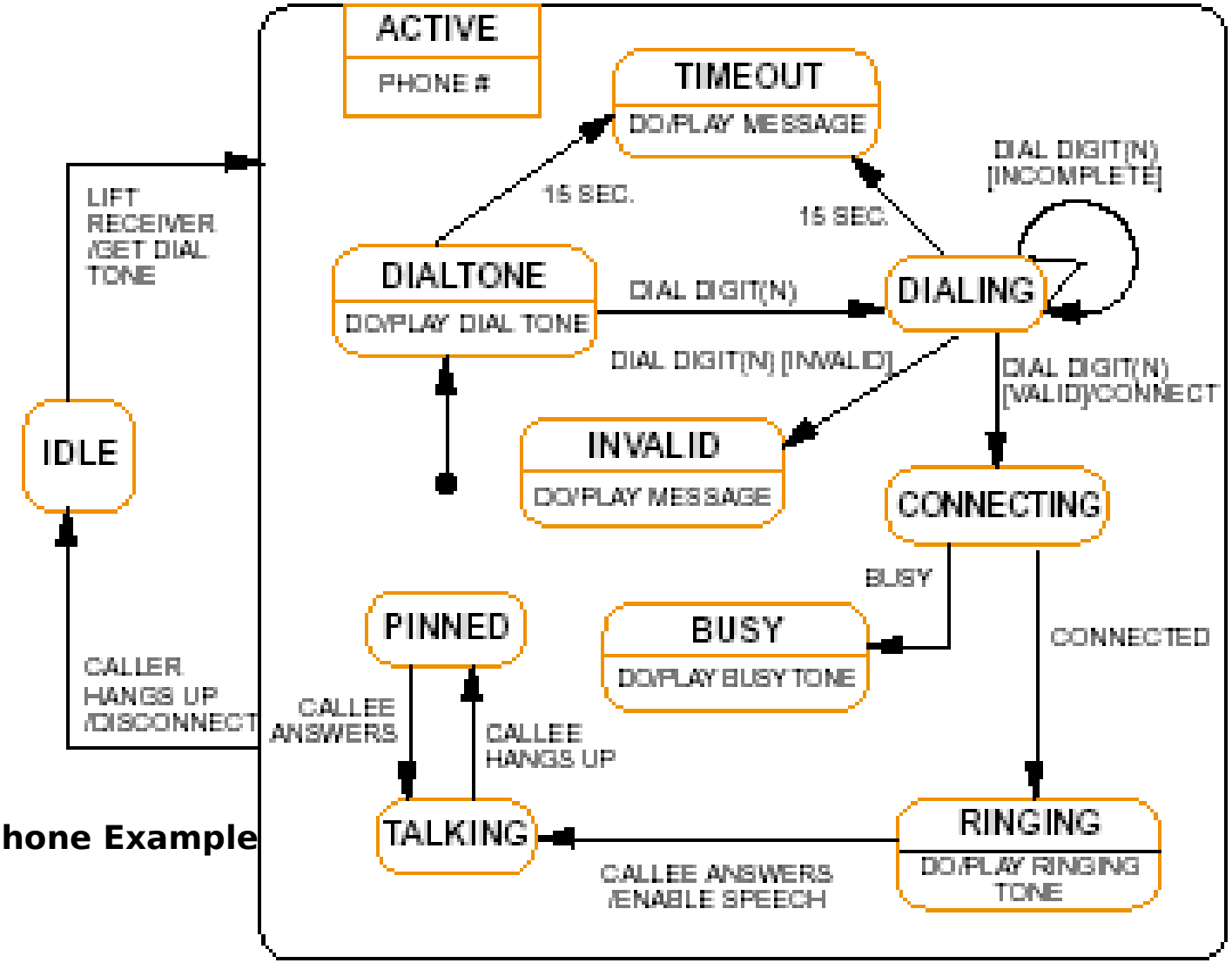


System Rules Model SV-10a

Action Assertion Example

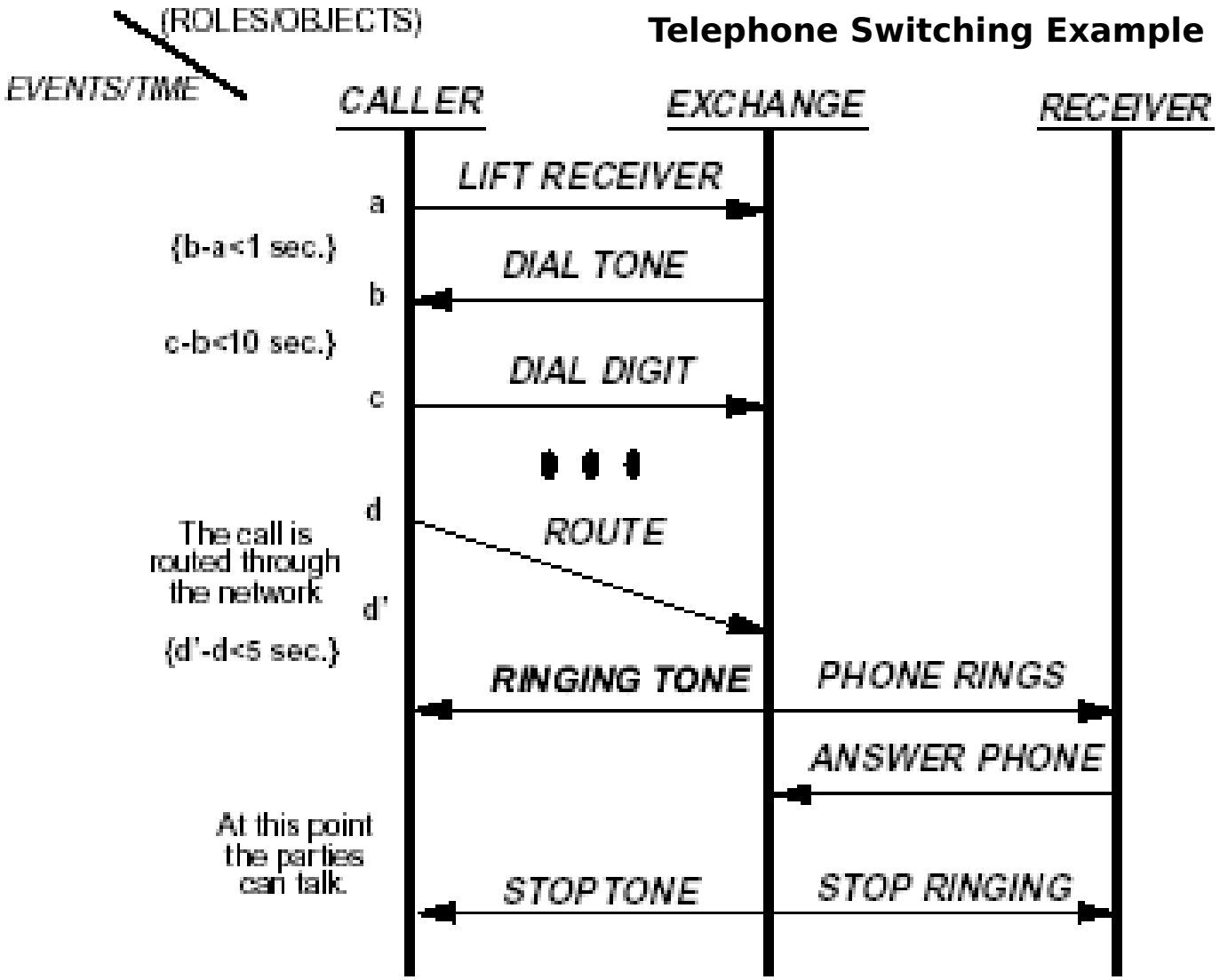
If field A *in* FORM-X *is set to* value T,
Then field B *in* FORM-Y *must be set to* value T
And field C *in* FORM-Z *must be set to* value T
End If

Systems State Transition Description - SV-10b



Telephone Example

Systems Event-Trace Description SV-10c



Architecture Products

Technical Standards View (TV)

Product	Product Name	General Description
TV-1	Technical Standards Profile	Extraction of standards that apply to a given architecture
TV-2	Technical Standards Forecast	Description of emerging standards that are expected to apply to the given architecture, within an appropriate set of timeframes

TV-1

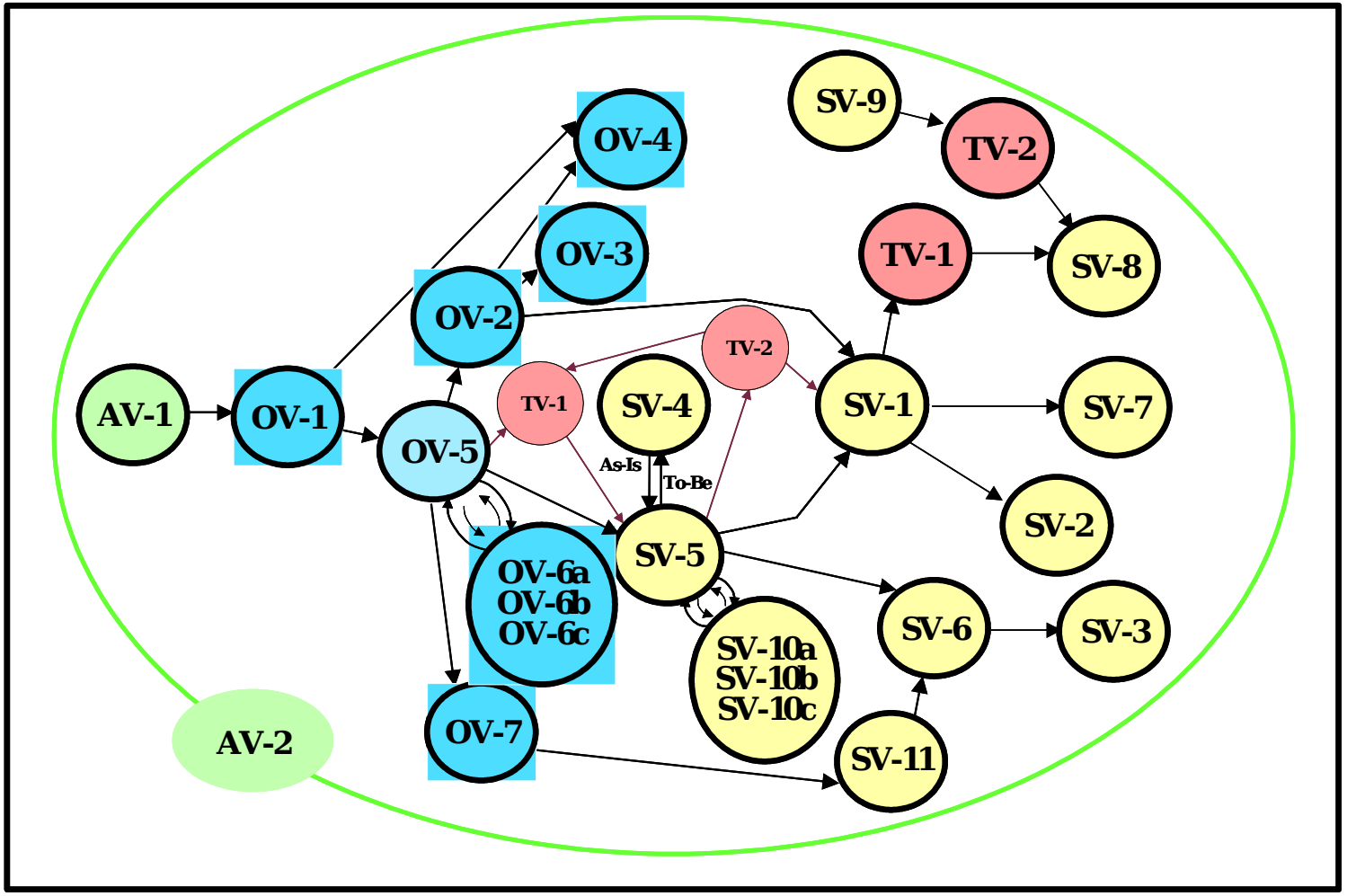
Technical Architecture Profile

Service Area	Service	Standard
Operating System	Kernel	FIPS Pub 151-1 (POSIX.1)
	Shell and Utilities	IEEE P1003.2
Software Engineering Services	Programming Languages	FIPS Pub 119 (ADA)
User Interface	Client Server Operations	FIPS Pub 158 (X-Window System)
	Object Definition and Management	DoD Human Computer Interface Style Guide
	Window Management	FIPS Pub 158 (X-Window System)
	Dialogue Support	Project Standard
Data Management	Data Management	FIPS Pub 127-2 (SQL)
Data Interchange	Data Interchange	FIPS Pub 152 (SGML)
	Electronic Data Interchange	FIPS Pub 161 (EDI)
Graphics	Graphics	FIPS Pub 153 (PHIGS)
. . .		

Relationships Between Products

- Individual Architecture Products are not stand-alone entities
- Products represent depictions of subsets of data describing various aspects of an architecture
- Relationships exist among the data that compose the various products
  - This creates relationships among the products

Data-Centric Build Sequence



Architecture Products by Use – Guidance from DoD AF

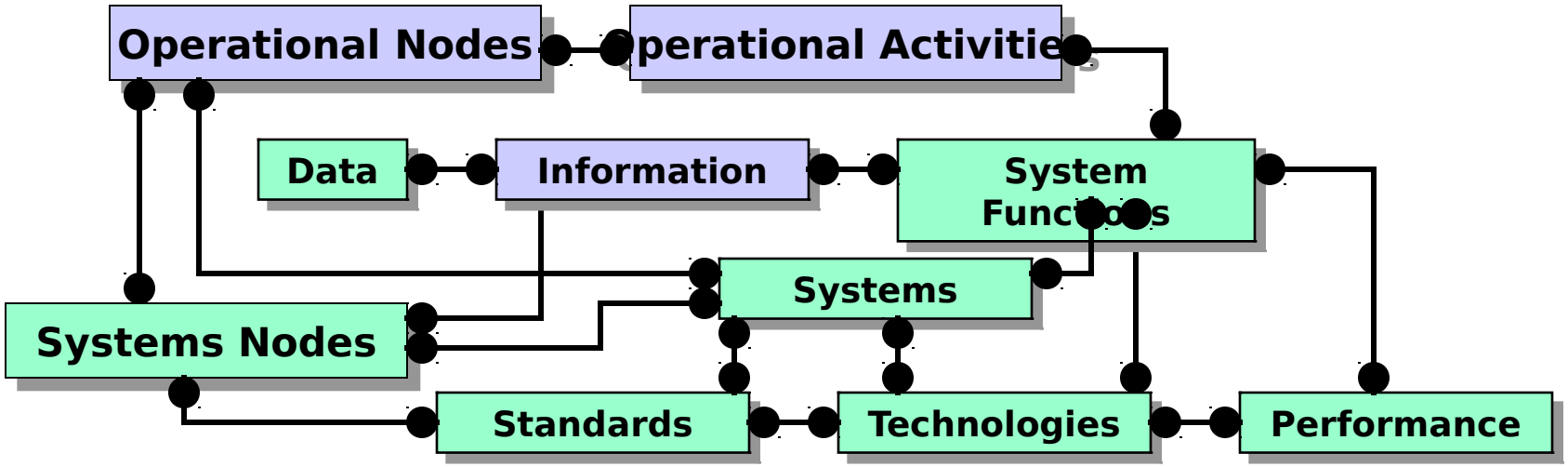
RECOMMENDED USES OF ARCHITECTURE:	APPLICABLE ARCHITECTURE PRODUCTS																					
	All-View		Operational View (OV)							System View (SV)												Tech Std View (TV)	
	1	2	1	2	3	4	5	6	7	1	2	3	4	5	6	7	8	9	10	11	1	2
Planning, Programming, Budgeting Process																						
PPBS	●	●	●	●	●	◉	◉	◉	◉	●	●	●	●	●	◉	◉	●	◉	◉			
Capability-Based Analysis for IT Investment Decisions	●	●	●	●	●	●	●	●	◉	●	●	●	●	●	●	●	●	●	●			
Modernization Planning (including AoAs)	●	●	●	●	●	◉	●	◉		◉	◉	◉	◉	◉				◉			◉	◉
Portfolio Management	●	●	●				●			◉			◉	●		◉	◉				◉	
Requirements Generation Process																						
Determining Mission Needs and Identifying Deficiencies	●	●	●	●	●	●	●	●		◉	◉		◉	◉	◉	◉			◉		◉	
CONOPS & TTP	●	●	●	●	●	●	●	●		◉	◉	◉	◉	◉							●	
BPR/FPI	●	●	◉	●	●	●	●	◉	●													
Acquisition Process																						
Program Definition and Risk Reduction	●	●	●	●	●	◉	●	●	◉	●	●	●	●	●	◉	◉	◉	◉	●		●	◉
Approval to Begin a New Acquisition Program	●	●	●	●	●	◉	●	●	◉	●	●	●	●	●	◉	◉	◉	◉	●		●	◉
Interoperability/Integration of C4ISR Systems	◉	◉	●	●	●	◉	◉	●	◉	●	◉	◉	◉	◉	●	◉	◉	◉	◉	◉	●	
Acquisition Strategy and Source Selection	●	●	●	●	●	◉	●	●	◉	●	●	●	●	●	◉	◉	◉	◉	●		●	◉
Cost, Schedule, and Performance Risk Management	●	●	●	●	●	◉	●	●	◉	●	●	●	●	●	◉	◉	◉	◉	●		●	◉
Life-Cycle Support & Integrated Digital Environment	●	●	●	●	●	◉	●	●	◉	●	●	●	●	●	◉	◉	◉	◉	●		●	◉
Operational and Developmental Test & Evaluation	●	●	●	●	●	●	●	●	◉	●	●	●	●	●	●	◉			●		●	
Systems Engineering (Design & Development)	●	●	●	●	●	◉	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	◉
Technology Insertion/Evolution	●	◉	●	◉	◉					◉			◉		◉	●	●	●			◉	◉
Operations (Assessment, Planning, Execution, ...)																						
Operations Planning & Execution	●	●	●	●	●	●	●	●	◉	●	●	◉	◉	◉	◉	◉			●			
Exercise Planning & Execution	●	●	●	●	●	●	●	●	◉	●	●	◉	◉	◉	◉	◉			●			
Organizational Design	●	●	●	●	●	●	●	◉	◉	◉	◉	◉	◉	◉	◉	◉					◉	

● = Product info is highly applicable ◉ = Info is often or partially applicable blank = Info is usually not applicable

Architectures: Data Model, Repository, and Tools

- Architectures have typically been developed as sets of graphical, tabular, or textual products
- Standards-Based Data-Centric Architectures
  - "Data-Centric": key product information is contained in a database
  - Data can be stored in a repository and manipulated by automated tools
  - Provide efficiency and flexibility
  - Enable architecture integration and reconciliation of data
  - Facilitate data maintainability and importability from authoritative data sources
- The Core Architecture Data Model (CADM):
  - Designed to provide a common approach for organizing and portraying the structure of architecture information
  - Intended to:
    - Facilitate the exchange, integration, and comparison of architecture information throughout the DoD
    - Help improve C4ISR interoperability

The Core Architecture Data Model
CADM



Core Architecture Data Model

- Developed cooperatively by representatives of OSD, Combatant Commands, Military Services, and Defense Agencies
- The DoD standard data model for Framework-based architecture data elements
- Built using the IDEF1x methodology, notation, and forms
- Evolving to support UML methodology, notation, and forms

CADM Overview

- The CADM is designed to provide a common approach for organizing and portraying the structure of the architecture information
- Truly intended to be a **core** architecture data model that focuses on a small set of common architectural data
- Individual Services, Commands, and Agencies will develop extensions to the model to meet their unique requirements
- The CADM will provide a point of mediation between and among products, databases, and other logical data models
- CADM is a **logical** (conceptual) rather than a **physical** data model
  - Primary purpose is to specify single-concept data requirements, formalizing both meaning and relationships of data
- CADM does not select the technology or other features of a physical implementation
  - Implementors are free to choose the form of the database and denormalize data structures
- By designing physical databases in logical conformance to CADM, developers can improve interoperability, increase data exchange, and enhance possibility of reuse from project to project

Architecture Views and Products

The 11 Oct 2002 Data Model has: 612 Entities with 3496 Attributes

7 Essential Views (2 AVs, 3 OVs, 1 SV, 1 TV)

19 Supporting Views (6 OVs, 12 SVs, 1 TV)

All Views

- **AV-1 Overview and Information Summary**
- **AV-2 Integrated Dictionary**
- AV-3 Capability Maturity Profile

Operational Views

- **OV-1 High-Level Operational Concept Description**
- **OV-2 Operational Node Connectivity Description**
- **OV-3 Operational Information Exchange Matrix**
- OV-4 Organizational Relationships Chart
- **OV-5 Activity Model**
- OV-6a Operational Rules Model
- OV-6b Operational State Transition Description
- OV-6c Operational Event/Trace Description
- OV-7 Logical Data Model

Boldface – **Essential Products**

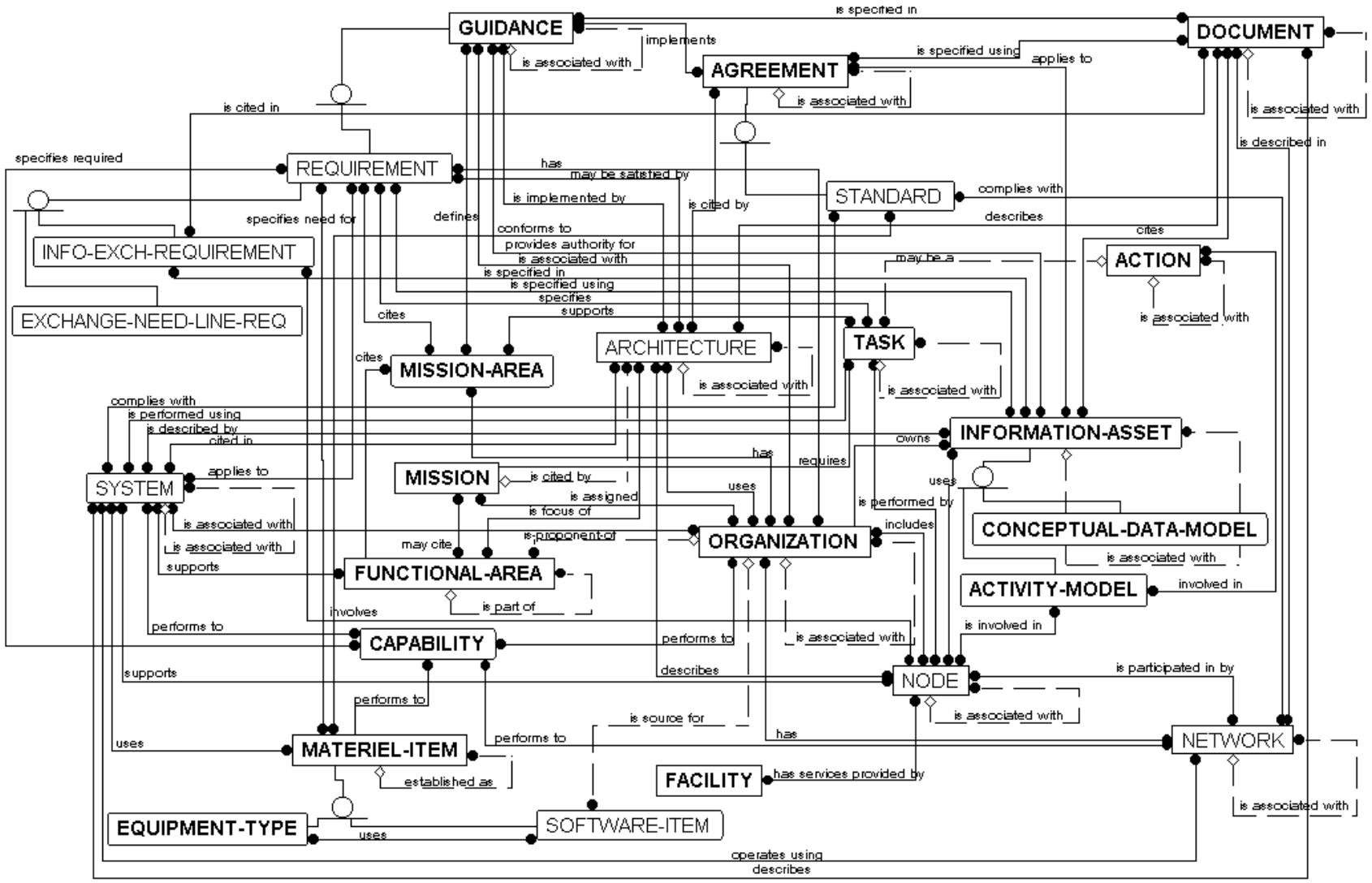
Systems Views

- **SV-1 System Interface Description**
- SV-2 Systems Communications Description
- SV-3 Systems Matrix
- SV-4 Systems Functionality Description
- SV-5 Operational Activity to System Function Traceability Matrix
- SV-6 System Data Exchange Matrix
- SV-7 System Performance Parameters Matrix
- SV-8 System Evolution Description
- SV-9 System Technology Forecast
- SV-10a Systems Rules Model
- SV-10b Systems State Transition Description
- SV-10c Systems Event/Trace Description
- SV-11 Physical Data Model

Technical Views

- **TV-1 Technical Architecture Profile**
- TV-2 Standards Technology Forecast

Key Entities and Relationships



NOTE: DoD standard entities are shown in bold font.

Mapping “Node” from CADM to FDMS

CADM Definition: A ZERO DIMENSIONAL TOPOLOGICAL PRIMITIVE THAT DEFINES TOPOLOGICAL RELATIONSHIPS. Note (CADM 2.0): A representation of an element of architecture that produces, consumes, or processes data.

NODE Category Codes

1 = AS--Assessment Node; 2 = C2 (BM)--Battle Management Node; 3 = CL--Collection Node; 4 = CD--Combat Direction Node; 5 = CM--Communications Node; 6 = EX (Weapon)--Execution Node; 7 = PR--Processing Node; 8 = PL--Platform; 9 = PA--Process Activity; 10 = SY--System; 11 = SE--System Element; 12 = O--Organization; 13 = P--Person; 97 = N--Not applicable; 98 = Not specified; 99 = X--Not known; 14 = SI--System Instance(s); 15 = OT--Organization Type; 16 = Facility; 17 = Process Activity; 18 = Task.

Mission and Means Framework

Fundamental Principles

And

Elements

Mission and Means Framework Goals

Organize and specify **operational** purposes and goals

Then relate, map, and allocate them to the proposed **technical** means for accomplishment

- **Warfare Representation**
  - Specifying the military **mission** and quantitatively evaluating the **mission utility** of alternative warfighting:

    Doctrine, Training, Organization, Leadership, Materiel, Personnel, and Facilities

    Services and **Products**
- Enable the warfighter, engineer, and comptroller to specify a common understanding of military **operations, systems, and information**
  - And provide quantitative **mission assessment** of alternative solutions

Mission and Means Framework Specific Objectives

- Unify the warfighter, engineer, and comptoller understanding of the missions and means
- Account for the tangible, physical, objectively measurable factors as well as the intangible, cognitive, ultimately subjective factors that constitute mission success
- Be sufficiently credible, timely, and affordable to make hard decisions – and have those decisions stay made
- Be sufficiently consistent, concise, repeatable, and scalable to compete effectively with alternative methodologies

Mission and Means Framework Fundamental Elements

Mission Content Levels

Stocking **Assembly**

Missions

- Level-7: Purpose Mission
- Level-6: Context Environment
- Level-5: Index Location/Time
- Level-4: Tasks Operations
- Level-3: Functions Capabilities

Means

- Level-2: Components Forces
- Level-1: Interactions Effects

Transformations (Synthesis, Employment)

- $O_{1,2x}$
  Level 1 Interaction Specifications
  into Level 2 Component States
- $O_{2,3x}$
  Level 2 Component States
  into Level 3 Functional Performance
- $O_{3,4x}$
  Level 3 Functional Performance
  into Level 4 Task Effectiveness
- $O_{4,1x}$
  Level 4 Task Sequence
  into Level 1 Interaction Conditions

Missions and Means Framework

Mission Content Levels

Mission

- **Level-7: Purpose Mission**

  The "Why" and "Wherefore." An assignment with a purpose that indicates the action to be taken. "What" the required outcomes are and "who" has been assigned them

- **Level-6: Context Environment**

  "Under what circumstances" a mission is to be accomplished.

- **Level-5: Index Location/Time**

  "Where" (geo-spatial) and "when" with what TPFDD execution matrix

- **Level-4: Tasks Operations**

  Task-based, outcome-centric specification of Operations that provide the Means to accomplish the Mission. Objective: organize Task outcomes: evaluate Mission effectiveness

- **Level-3: Functions Capabilities**

  Function-based, performance-centric "how well" specifications of Capabilities.

- **Level-2: Components Forces**

  Component-based, state-centric specifications of the Forces that provide the Means. Network of units, personnel, and equipment. Physical and logical networking.

- **Level-1: Interactions Effects**

  Interaction-based, phenomena-centric specification of Effects of Operations on Forces

Means

CADM Architecture Products

Applicable Architecture View	Product Reference	Architecture Product	Essential or Supporting	General Nature
All Views (Context)	AV-1	***Overview and Summary Information***	**Essential**	Scope, purpose, intended users, environment depicted, analytical findings, if applicable *(4.2.1.1)*
All Views (Terms)	AV-2	***Integrated Dictionary***	**Essential**	Definitions of all terms used in all products *(4.2.1.2)*
Operational	OV-1	***High-level Operational Concept Graphic***	**Essential**	High-level graphical description of operational concept (high-level organizations, missions, geographic configuration, connectivity, etc.) *(4.2.1.3)*
Operational	OV-2	***Operational Node Connectivity Description***	**Essential**	Operational nodes, activities performed at each node, connectivities & information flow between nodes *(4.2.1.4)*
Operational	OV-3	***Operational Information Exchange Matrix***	**Essential**	Information exchanged between nodes and the relevant attributes of that exchange such as media, quality, quantity, and the level of interoperability required *(4.2.1.5)*
Operational	OV-4	***Command Relationships Chart***	Supporting	Command, control, coordination relationships among organizations *(4.2.2.1)*
Operational	OV-5	***Activity Model***	Supporting	Activities, relationships among activities, I/Os, constraints (e.g., policy, guidance), and mechanisms that perform those activities. In addition to showing mechanisms, overlays can show other pertinent information *(4.2.2.2)*
Operational	OV-6a	***Operational Rules Model***	Supporting	One of the three products used to describe operational activity sequence and timing that identifies the business rules that constrain the operation *(4.2.2.3.1)*
Operational	OV-6b	***Operational State Transition Description***	Supporting	One of the three products used to describe operational activity sequence and timing that identifies responses of a business process to events *(4.2.2.3.2)*
Operational	OV-6c	***Operational Event/Trace Description***	Supporting	One of the three products used to describe operational activity sequence and timing that traces the actions in a scenario or critical sequence of events *(4.2.2.3.3)*
Operational	OV-7	***Logical Data Model***	Supporting	Documentation of the data requirements and structural business process rules of the Operational View *(4.2.2.4)*
Systems	SV-1	***System Interface Description***	**Essential**	Identification of systems and system components and their interfaces, within and between nodes *(4.2.1.6)*
Systems	SV-2	***Systems Communications Description***	Supporting	Physical nodes and their related communications laydowns *(4.2.2.5)*
Systems	SV-3	***Systems² Matrix***	Supporting	Relationships among systems in a given architecture; can be designed to show relationships of interest, e.g., system-type interfaces, planned vs. existing interfaces, etc. *(4.2.2.6)*
Systems	SV-4	***Systems Functionality Description***	Supporting	Functions performed by systems and the information flow among system functions *(4.2.2.7)*
Systems	SV-5	***Operational Activity to System Function Traceability Matrix***	Supporting	Mapping of system functions back to operational activities *(4.2.2.8)*
Systems	SV-6	***System Information Exchange Matrix***	Supporting	Detailing of information exchanges among system elements, applications and H/W allocated to system elements *(4.2.2.9)*
Systems	SV-7	***System Performance Parameters Matrix***	Supporting	Performance characteristics of each system(s) hardware and software elements, for the appropriate timeframe(s) *(4.2.2.10)*
Systems	SV-8	***System Evolution Description***	Supporting	Planned incremental steps toward migrating a suite of systems to a more efficient suite, or toward evolving a current system to a future implementation *(4.2.2.11)*
Systems	SV-9	***System Technology Forecast***	Supporting	Emerging technologies and software/hardware products that are expected to be available in a given set of timeframes, and that will affect future development of the architecture *(4.2.2.12)*
Systems	SV-10a	***Systems Rules Model***	Supporting	One of three products used to describe systems activity sequence and timing -- Constraints that are imposed on systems functionality due to some aspect of systems design or implementation *(4.2.2.13.1)*
Systems	SV- 10b	***Systems State Transition Description***	Supporting	One of three products used to describe systems activity sequence and timing -- Responses of a system to events *(4.2.2.13.2)*
Systems	SV -10c	***Systems Event/Trace Description***	Supporting	One of three products used to describe systems activity sequence and timing -- System-specific refinements of critical sequences of events described in the operational view *(4.2.2.13.3)*
Systems	SV-11	***Physical Data Model***	Supporting	Physical implementation of the information of the Logical Data Model, e.g., message formats, file structures, physical schema *(4.2.2.14)*
Technical	TV-1	***Technical Architecture Profile***	**Essential**	Extraction of standards that apply to the given architecture *(4.2.1.7)*
Technical	TV-2	***Standards Technology Forecast***	Supporting	Description of emerging standards that are expected to apply to the given architecture, within an appropriate set of timeframes *(4.2.2.15)*

Mapping MMF to DoDAF Products

MMF Mission

Level-7: Purpose Mission

The "Why" and "Wherefore." An assignment with a purpose that indicates the action to be taken. "What" the required outcomes are and "who" has been assigned them

Level-6: Environment Context

"Under what circumstances" a mission is to be accomplished.

Level-5: Index Location/Time

"Where" (geo-spatial) and "when" with what TPFDD execution matrix

Architecture Views

Operational View

- What is going on in the real world that is to be supported or enabled
- Activities performed as part of DoD missions
- Associated information exchanges among personnel or organizations
- Reveals requirements for capabilities and interoperability

Systems View supports DoD needs documented in operational view

- Existing and future systems
- Physical interconnections

Technical Standards View

- Catalogs standard (COTS,GOTS) system parts or components and their interconnections
- Augments the systems view with technical detail and forecasts of standard technology evolution

All View – augments the other views by providing:

- Context, Summary
- Overview-Level Information – scope, purpose, environment
- Integrated Dictionary to define terms

Mapping MMF to DoDAF Products

MMF Mission

Level-7: Purpose Mission

The "Why" and "Wherefore." An assignment with a purpose that indicates the action to be taken. "What" the required outcomes are and "who" has been assigned them

Level-6: Environment Context

"Under what circumstances" a mission is to be accomplished.

Level-5: Index Location/Time

"Where" (geo-spatial) and "when" with what TPFDD execution matrix

Architecture Views

OV-1

OV-1

AV-1

AV-1

AV-1

Operational View

What is going on in the real world that is to be supported or enabled

Activities performed as part of DoD missions

Associated information exchanges among personnel or organizations

Reveals requirements for capabilities and interoperability

Systems View supports DoD needs documented in operational view

Existing and future systems

Physical interconnections

Technical Standards View

Catalogs standard (COTS,GOTS) system parts or components and their interconnections

Augments the systems view with technical detail and forecasts of standard technology evolution

All View – augments the other views by providing:

Context, Summary

Overview-Level Information – scope, purpose, environment

Integrated Dictionary to define terms

Mapping MMF to DoDAF Products

MMF Means

Level-4: Tasks Operations

Task-based, outcome-centric specification of Operations that provide the Means to accomplish the Mission. Objective: organize Task outcomes, evaluate Mission effectiveness

Level-3: Functions Capabilities

Function-based, performance-centric "how well" specifications of Capabilities.

Level-2: Components Forces

Component-based, state-centric specifications of the Forces that provide the Means. Network of units, personnel, and equipment. Physical and logical networking.

Level-1: Interactions Effects

Interaction-based, phenomena-centric specification of Effects of Operations on Forces

Architecture Views

Operational View

- What is going on in the real world that is to be supported or enabled
- Activities performed as part of DoD missions
- Associated information exchanges among personnel or organizations
- Reveals requirements for capabilities and interoperability

Systems View supports DoD needs documented in operational view

- Existing and future systems
- Physical interconnections

Technical Standards View

- Catalogs standard (COTS,GOTS) system parts or components and their interconnections
- Augments the systems view with technical detail and forecasts of standard technology evolution

All View – augments the other views by providing:

- Context, Summary
- Overview-Level Information – scope, purpose, environment
- Integrated Dictionary to define terms

Mapping MMF to DoDAF Products

MMF Means

Level-4: Tasks Operations

Task-based, outcome-centric specification of Operations that provide the Means to accomplish the Mission. Objective: organize Task outcomes, evaluate Mission effectiveness

Level-3: Functions Capabilities

Function-based, performance-centric "how well" specifications of Capabilities.

Level-2: Components Forces

Component-based, state-centric specifications of the Forces that provide the Means. Network of units, personnel, and equipment. Physical and logical networking.

Level-1: Interactions Effects

Interaction-based, phenomena-centric specification of Effects of Operations on Forces

Architecture Views

OV-5

OV-5

OV-2
OV-3
OV-4

Operational View

What is going on in the real world that is to be supported or enabled

Activities performed as part of DoD missions

Associated information exchanges among personnel or organizations

Reveals requirements for capabilities and interoperability

Systems View supports DoD needs documented in operational view

OV-6a
OV-6b
OV-6c
OV-7

Existing and future systems

Physical interconnections

Technical Standards View

Catalogs standard (COTS,GOTS) system parts or components and their interconnections

Augments the systems view with technical detail and forecasts of standard technology evolution

All View – augments the other views by providing:

Context, Summary

Overview-Level Information – scope, purpose, environment

Integrated Dictionary to define terms

Mapping MMF to DoDAF Products

MMF Means

Level-4: Tasks Operations

Task-based, outcome-centric specification of Operations that provide the Means to accomplish the Mission. Objective: organize Task outcomes, evaluate Mission effectiveness

Level-3: Functions Capabilities

Function-based, performance-centric "how well" specifications of Capabilities.

Level-2: Components Forces

Component-based, state-centric specifications of the Forces that provide the Means. Network of units, personnel, and equipment. Physical and logical networking.

Level-1: Interactions Effects

Interaction-based, phenomena-centric specification of Effects of Operations on Forces

Architecture Views

SV-1
SV-2
SV-3
SV-4

SV-5
SV-6
SV-7
SV-8
SV-9

SV-11

SV-10a
SV-10b
SV-10c

TV-1
TV-2

Operational View

- What is going on in the real w… at is to be supported or enabled
- Activities performed as part o… missions
- Associated information exch… mong personnel or organizations
- Reveals requirements for capabilities and interoperability

Systems View supports DoD needs documented in operational view

- Existing and future systems
- …hysical interconnections

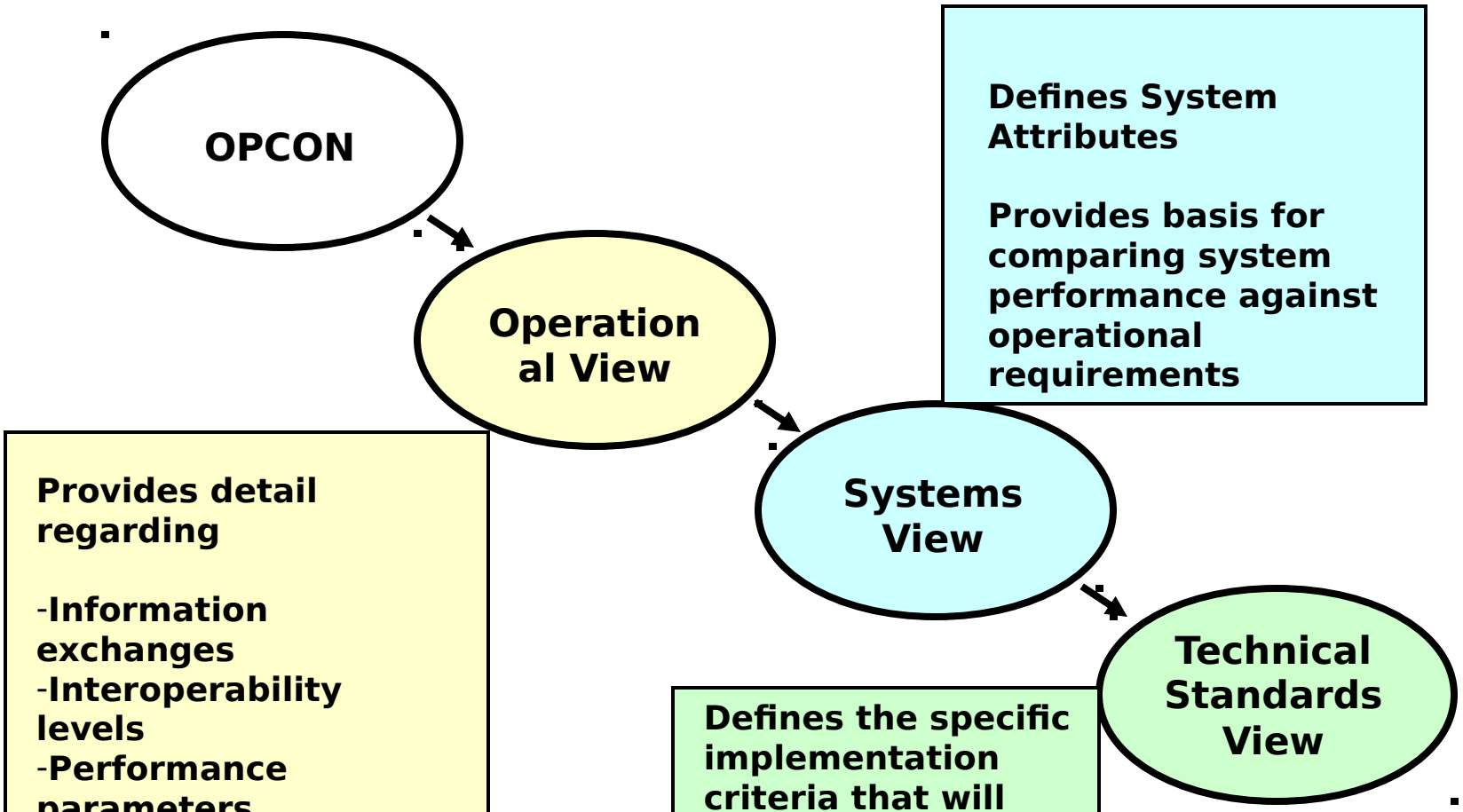
…nical Standards View

- …atalogs standard (COTS,GOTS) system parts or components and their interconnections
- Augments the systems view with technical detail and forecasts of standard technology evolution

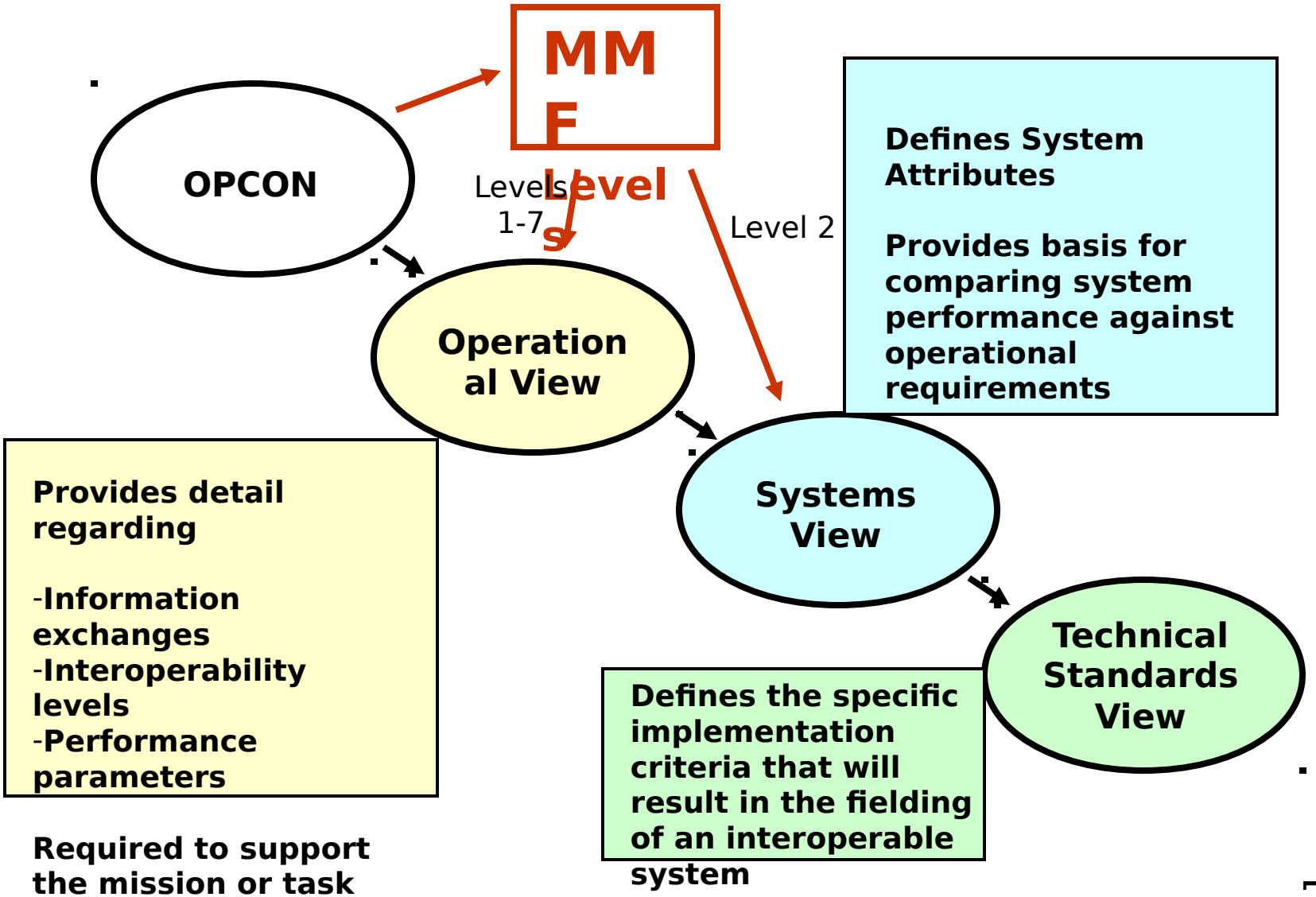
All View – augments the other views by providing:

- Context, Summary
- Overview-Level Information – scope, purpose, environment
- Integrated Dictionary to define terms

Linkages Among the Views


OPCON
Operation al View
Systems View
Technical Standards View
Defines System Attributes
Provides basis for comparing system performance against operational requirements
Provides detail regarding
-Information exchanges
-Interoperability levels
-Performance parameters
Required to support the mission or task
Defines the specific implementation criteria that will result in the fielding of an interoperable system

Linkages Among the Views



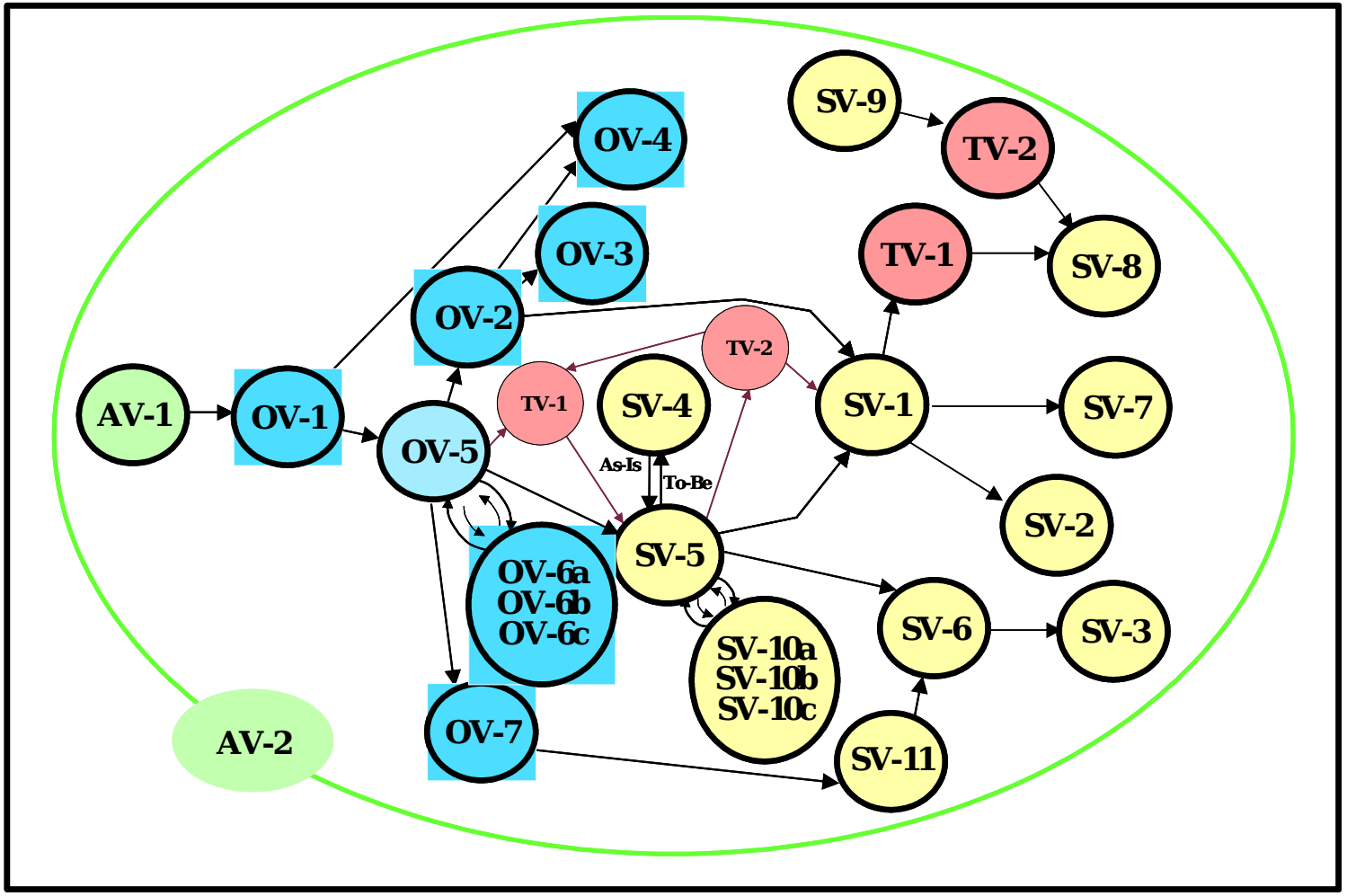
Summary – MMF Mission Content Levels

- **Level-7: Purpose Mission** **OV-1 AV-1**
  The "Why" and "Wherefore." An assignment with a purpose that indicates the action to be taken. "What" the required outcomes are and "who" has been assigned them
- **Level-6: Environment Context** **AV-1**
  "Under what circumstances" a mission is to be accomplished.
- **Level-5: Index Location/Time** **OV-1 AV-1**
  "Where" (geo-spatial) and "when" with what TPFDD execution matrix
- **Level-4: Tasks Operations** **OV-5**
  Task-based, outcome-centric specification of Operations that provide the Means to accomplish the Mission. Objective: organize Task outcomes, evaluate Mission effectiveness
- **Level-3: Functions Capabilities** **OV-5 SV-11**
  Function-based, performance-centric "how well" specifications of Capabilities.
- **Level-2: Components Forces** **OV-2 OV-3 OV-4 All SV**
  Component-based, state-centric specifications of the Forces that provide the Means. Network of units, personnel, and equipment. Physical and logical networking.
- **Level-1: Interactions Effects** **OV-6a,OV-6b,OV-6c,OV-7 SV-10a,SV-10b,SV-10c**
  Interaction-based, phenomena-centric specification of Effects of Operations on Forces

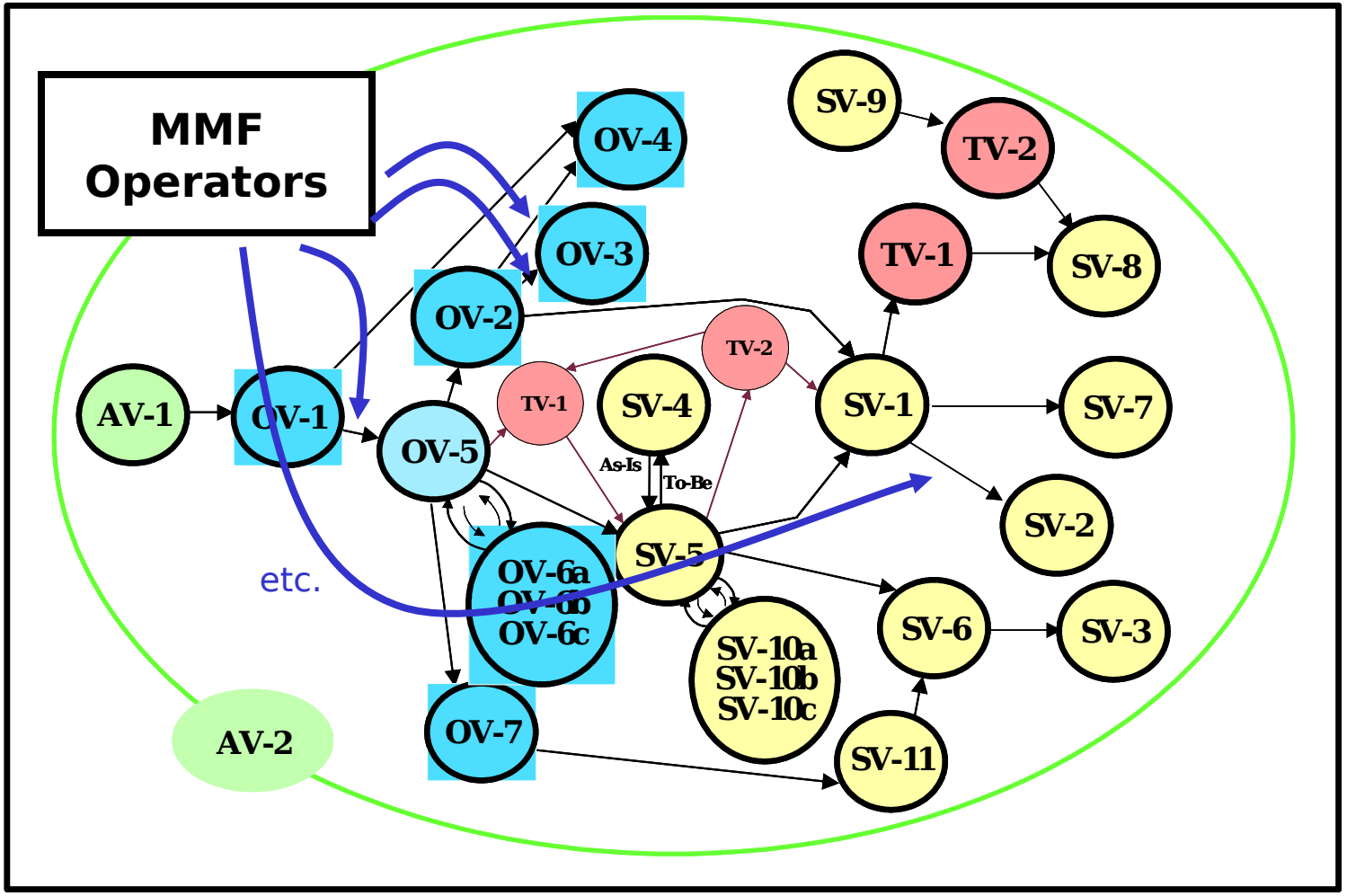
MMF Transformational Operators

- **Level-7: Purpose Mission OV-1 AV-1**
  The "Why" and "Wherefore." An assignment with a purpose that indicates the action to be taken. "What" the required outcomes are and "who" has been assigned them
- **Level-6: Environment Context AV-1**
  "Under what circumstances" a mission is to be accomplished.
- **Level-5: Index Location/Time OV-1 AV-1**
  "Where" (geo-spatial) and "when" with what TPFDD execution matrix
- **Level-4: Tasks Operations OV-5**
  Task-based, outcome-centric specification of Operations that provide the Means to accomplish the Mission. Objective: organize Task outcomes, evaluate Mission effectiveness
- **Level-3: Functions Capabilities OV-5 SV-11**
  Function-based, performance-centric "how well" specifications of Capabilities.
- **Level-2: Components Forces OV-2 OV-3 OV-4 All SV**
  Component-based, state-centric specifications of the Forces that provide the Means. Network of units, personnel, and equipment. Physical and logical networking.
- **Level-1: Interactions Effects OV-6a,OV-6b,OV-6c,OV-7 SV-10a,SV-10b,SV-10c**
  Interaction-based, phenomena-centric specification of Effects of Operations on Forces

Data-Centric Build Sequence



Data-Centric Build Sequence



Conclusions

- **The Seven Fundamental Levels of Analysis for the Mission and Means Framework can be successfully mapped to specific products of the DoD Architecture Framework**

- **The following aspects of the MMF could be logically captured in the natural construction and refinement process for each Architecture View;**
  - **Transformational Operators ($O_{1,2S,}$etc)**
  - **Stocking and Assembly Perspectives**
  - **Synthesis and Employment processes**

- **DoD AF architecture products are particularly well-suited to explicitly specifying the military mission of the MMF**

- **The quantitative evaluation of the mission utility of alternative warfighting DTLOMPF services and products will be difficult**